$B^{\pm}/B^0/B_s^0/b$ -baryon ADMIXTURE

$B^{\pm}/B^{0}/B_{s}^{0}/b$ -baryon ADMIXTURE MEAN LIFE

Each measurement of the *B* mean life is an average over an admixture of various bottom mesons and baryons which decay weakly. Different techniques emphasize different admixtures of produced particles, which could result in a different *B* mean life.

"OUR EVALUATION" is an average using rescaled values of the data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at https://hflav.web.cern.ch/. This is a weighted average of the lifetimes of the five main b-hadron species (B^+ , B^0 , B^0_{sH} , B^0_{sL} , and Λ_b) that assumes the production fractions in Z decays (given at the end of this section) and equal production fractions of B^0_{sH} and B^0_{sL} mesons.

VALUE (10^{-12} s) __EVTS __DOCUMENT ID __TECN __COMMENT

1.5672 ± 0.0029 OUR EVALUATION

• • We do not use the following data for averages, fits, limits, etc.

```
<sup>1</sup> ABDALLAH
                                                                  DLPH e^+e^- \rightarrow Z
1.570 \pm 0.005 \pm 0.008
                  +0.035
                                       <sup>2</sup> ABE
1.533 \pm 0.015
                                                                  CDF
                                                                            p\overline{p} at 1.8 TeV
                    -0.031
                                       <sup>3</sup> ACCIARRI
                                                                  L3
1.549 \pm 0.009 \pm 0.015
                                       <sup>4</sup> ACKERSTAFF 97F
                                                                  OPAL
1.611 \pm 0.010 \pm 0.027
                                       <sup>4</sup> ABREU
                                                                  DLPH e^+e^- \rightarrow Z
1.582 \pm 0.011 \pm 0.027
                                       <sup>5</sup> ABREU
                                                                  DLPH e^+e^- \rightarrow Z
1.575 \pm 0.010 \pm 0.026
                                       <sup>6</sup> BUSKULIC
1.533 \pm 0.013 \pm 0.0229.8 k
                                                            96F
                                                                  ALEP
                                       <sup>7</sup> ABE,K
                                                            95B
                                                                  SLD
1.564 \pm 0.030 \pm 0.036
                                       <sup>8</sup> ABREU
1.542\ \pm0.021\ \pm0.045
                                                            94L
                                                                  DLPH e^+e^- \rightarrow Z
        +0.24
                                       <sup>9</sup> ABREU
                  \pm 0.03
1.50
        -0.21
                                     10 ABF
       \pm 0.06
                  \pm 0.065344
                                                                  CDF
                                                                            Repl. by ABE 98B
1.46
        +0.14
                                     <sup>11</sup> ABREU
                  \pm 0.15 188
1.23
                                                                            Sup. by ABREU 94L
        -0.13
                                     <sup>12</sup> ABREU
                  \pm 0.12 253
                                                                  DLPH
                                                                            Sup. by ABREU 94L
1.49
       \pm 0.11
        +0.16
                                     <sup>13</sup> ACTON
                                                                  OPAL e^+e^- \rightarrow Z
1.51
                   \pm 0.11 130
        -0.14
                                     <sup>14</sup> ACTON
                                                                            e^+e^- \rightarrow Z
1.523 \pm 0.034 \pm 0.0385372
                                     <sup>14</sup> ADRIANI
1.535 \pm 0.035 \pm 0.0287357
                                                                            Repl. by ACCIARRI 98
                                     <sup>15</sup> BUSKULIC
                                                            930
                                                                  ALEP
                                                                            e^+e^- \rightarrow Z
1.511 \pm 0.022 \pm 0.078
                                     <sup>16</sup> ABREU
1.28
        \pm 0.10
                                                                  DLPH
                                                                            Sup. by ABREU 94L
                                     <sup>17</sup> ACTON
1.37
        \pm\,0.07
                  \pm 0.061354
                                                                  OPAL
                                                                            Sup. by ACTON 93L
                                     <sup>18</sup> BUSKULIC
                                                                  ALEP
                                                                            Sup. by BUSKULIC 96F
1.49
        \pm 0.03
                  \pm 0.06
                                                            92F
        +0.19
                                     <sup>19</sup> BUSKULIC
                                                                            e^+e^- \rightarrow Z
                                                                  ALEP
1.35
                  \pm 0.05
        -0.17
                                     <sup>20</sup> ADEVA
                                                            91H L3
                                                                            Sup. by ADRIANI 93K
       \pm 0.08
                  \pm 0.091386
1.32
       +0.31 \\ -0.25
                                     ^{21} ALEXANDER 91G OPAL e^+e^- \rightarrow Z
                  \pm 0.15
1.32
```

1.29	±0.06	±0.102973	²² DECAMP	91 C	ALEP	Sup. by BUSKULIC 92F
1.36	$+0.25 \\ -0.23$		²³ HAGEMANN	90	JADE	E ^{ee} _{cm} = 35 GeV
1.13	±0.15		²⁴ LYONS	90	RVUE	
1.35	±0.10	± 0.24	BRAUNSCH	89 B	TASS	$E_{\rm cm}^{\it ee}$ = 35 GeV
0.98	±0.12	± 0.13	ONG	89	MRK2	E ^{ee} _{cm} = 29 GeV
1.17	$^{+0.27}_{-0.22}$	$^{+0.17}_{-0.16}$	KLEM	88	DLCO	Eee = 29 GeV
1.29	±0.20	± 0.21	²⁵ ASH	87	MAC	Eee = 29 GeV
1.02	$+0.42 \\ -0.39$	301	²⁶ BROM	87	HRS	E ^{ee} _{cm} = 29 GeV

¹ Measurement performed using an inclusive reconstruction and B flavor identification

² Measured using inclusive $J/\psi(1S) \rightarrow \mu^{+}\mu^{-}$ vertex.

³ACCIARRI 98 uses inclusively reconstructed secondary vertex and lepton impact param-

⁴ ACKERSTAFF 97F uses inclusively reconstructed secondary vertices.

⁵ Combines ABREU 96E secondary vertex result with ABREU 94L impact parameter result.

⁶ BUSKULIC 96F analyzed using 3D impact parameter.

⁷ ABE,K 95B uses an inclusive topological technique.

⁸ ABREU 94L uses charged particle impact parameters. Their result from inclusively reconstructed secondary vertices is superseded by ABREU 96E.

 $^{^9}$ From proper time distribution of $b o J/\psi(1S)$ anything.

 $^{^{10}}$ ABE 93J analyzed using $J/\psi(1S)
ightarrow ~\mu \mu$ vertices.

¹¹ABREU 93D data analyzed using $D/D^*\ell$ anything event vertices.

 $^{^{12}}$ ABREU 93G data analyzed using charged and neutral vertices.

¹³ACTON 93C analysed using $D/D^*\ell$ anything event vertices.

 $^{^{14}}$ ACTON 93L and ADRIANI 93K analyzed using lepton (e and μ) impact parameter at Z.

¹⁵BUSKULIC 930 analyzed using dipole method.

 $^{^{16}}$ ABREU 92 is combined result of muon and hadron impact parameter analyses. Hadron tracks gave $(12.7 \pm 0.4 \pm 1.2) \times 10^{-13}$ s for an admixture of B species weighted by production fraction and mean charge multiplicity, while muon tracks gave $(13.0\pm1.0\pm0.8)\times$ 10^{-13} s for an admixture weighted by production fraction and semileptonic branching fraction. 17 ACTON 92 is combined result of muon and electron impact parameter analyses.

 $^{^{}m 18}$ BUSKULIC 92F uses the lepton impact parameter distribution for data from the 1991

 $^{^{19}}$ BUSKULIC 92G use $J/\psi(1S)$ tags to measure the average b lifetime. This is comparable to other methods only if the $J/\psi(1S)$ branching fractions of the different b-flavored hadrons are in the same ratio.

 $^{^{20}}$ Using $Z
ightarrow e^+ {
m X}$ or $\mu^+ {
m X}$, ADEVA 91H determined the average lifetime for an admixture of B hadrons from the impact parameter distribution of the lepton.

²¹ Using $Z \to J/\psi(1S)$ X, $J/\psi(1S) \to \ell^+\ell^-$, ALEXANDER 91G determined the average lifetime for an admixture of B hadrons from the decay point of the $J/\psi(1S)$.

²² Using $Z \rightarrow e X$ or μX , DECAMP 91C determines the average lifetime for an admixture of B hadrons from the signed impact parameter distribution of the lepton.

²³ HAGEMANN 90 uses electrons and muons in an impact parameter analysis.

²⁴LYONS 90 combine the results of the B lifetime measurements of ONG 89, BRAUN-SCHWEIG 89B, KLEM 88, and ASH 87, and JADE data by private communication. They use statistical techniques which include variation of the error with the mean life, and possible correlations between the systematic errors. This result is not independent of the measured results used in our average.

 $^{^{25}}$ We have combined an overall scale error of 15% in quadrature with the systematic error of ± 0.7 to obtain ± 2.1 systematic error.

²⁶ Statistical and systematic errors were combined by BROM 87.

CHARGED b-HADRON ADMIXTURE MEAN LIFE

NEUTRAL b-HADRON ADMIXTURE MEAN LIFE

MEAN LIFE RATIO $au_{ ext{charged }b- ext{hadron}}/ au_{ ext{neutral }b- ext{hadron}}$

VALUEDOCUMENT IDTECNCOMMENT $1.09^{+0.11}_{-0.10} \pm 0.08$ 1 ADAM95 DLPH $e^+e^- \rightarrow Z$

 $^{
m 1}$ ADAM 95 data analyzed using vertex-charge technique to tag \emph{b} -hadron charge.

$|\Delta \tau_b|/\tau_{b,\overline{b}}$

 $\tau_{b,\overline{b}}$ and $|\Delta\tau_b|$ are the mean life average and difference between b and \overline{b} hadrons.

VALUEDOCUMENT IDTECNCOMMENT $-0.001 \pm 0.012 \pm 0.008$ 1 ABBIENDI99JOPAL $e^+e^- \rightarrow Z$

\overline{b} PRODUCTION FRACTIONS AND DECAY MODES

The branching fraction measurements are for an admixture of B mesons and baryons at energies above the $\Upsilon(4S)$. Only the highest energy results (LHC, LEP, Tevatron, $Sp\overline{p}S$) are used in the branching fraction averages. In the following, we assume that the production fractions are the same at the LHC, LEP, and at the Tevatron.

For inclusive branching fractions, e.g., $B \to D^\pm$ anything, the values usually are multiplicities, not branching fractions. They can be greater than one.

The modes below are listed for a \overline{b} initial state. b modes are their charge conjugates. Reactions indicate the weak decay vertex and do not include mixing.

 $^{^{1}}$ Data analyzed using both the jet charge and the charge of secondary vertex in the opposite hemisphere.

PRODUCTION FRACTIONS

The production fractions for weakly decaying b-hadrons at high energy have been calculated from the best values of mean lives, mixing parameters, and branching fractions in this edition by the Heavy Flavor Averaging Group (HFLAV) as described in the note " B^0 - \overline{B}^0 Mixing" in the B^0 Particle Listings. We no longer provide world averages of the b-hadron production fractions, where results from LEP, Tevatron and LHC are averaged together; indeed the available data (from CDF and LHCb) shows that the fractions depend on the kinematics (in particular the p_T) of the produced b hadron. Hence we would like to list the fractions in Z decays instead, which are well-defined physics observables. The production fractions in $p_{\overline{p}}$ collisions at the Tevatron are also listed at the end of the section. Values assume

$$\begin{array}{ll} \mathsf{B}(\overline{b}\to \ B^+) = \mathsf{B}(\overline{b}\to \ B^0) \\ \mathsf{B}(\overline{b}\to \ B^+) + \mathsf{B}(\overline{b}\to \ B^0) + \mathsf{B}(\overline{b}\to \ B^0) + \mathsf{B}(b\to \ b\text{-baryon}) = 100\%. \end{array}$$

The correlation coefficients between production fractions are also reported:

$$cor(B_s^0, b\text{-baryon}) = 0.064$$

 $cor(B_s^0, B^{\pm} = B^0) = -0.633$
 $cor(b\text{-baryon}, B^{\pm} = B^0) = -0.813.$

The notation for production fractions varies in the literature $(f_d, d_{B^0}, f(b \to \overline{B}^0), \operatorname{Br}(b \to \overline{B}^0))$. We use our own branching fraction notation here, $\operatorname{B}(\overline{b} \to B^0)$.

Note these production fractions are b-hadronization fractions, not the conventional branching fractions of b-quark to a B-hadron, which may have considerable dependence on the initial and final state kinematic and production environment.

Γ_1	B^+	$(40.8 \pm 0.7)\%$
Γ_2	B^0	(40.8 ± 0.7) %
Γ_3	B_s^0	($10.0~\pm~0.8$) %
Γ_4	B_c^+	
Γ_5	<i>b</i> -baryon	(8.4 \pm 1.1) %

DECAY MODES

Semileptonic and leptonic modes

Γ ₆	u anything	$(23.1 \pm 1.5)\%$	
Γ_7	$\ell^+ u_\ell$ anything	[a] $(10.69\pm~0.22)~\%$	
Γ ₈	$e^+ u_e$ anything	$(10.86\pm\ 0.35)\%$	
Γ ₉	$\mu^+ u_\mu$ anything	(10.95^{+}_{-} $\stackrel{0.29}{0.25}$) %	
Γ_{10}	$D^-\ell^+ u_\ell$ anything	[a] (2.2 \pm 0.4) %	=1.9
	$D^-\pi^+\ell^+ u_\ell$ anything	$(4.9 \pm 1.9) \times 10^{-3}$	
	$D^-\pi^-\ell^+ u_\ell$ anything	$(2.6 \pm 1.6) \times 10^{-3}$	
Γ_{13}	$\overline{\it D}{}^0\ell^+ u_\ell$ anything	[a] $(6.79 \pm 0.34)\%$	

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 $\Gamma_{41} D^0 D^*(2010)^{\pm}$ anything

[c] $(3.0 + 1.1 \atop -0.0)\%$

```
D^*(2010)^{\pm}D^{\mp} anything
                                                                                                                     [c] (2.5 + 1.2)\%
\Gamma_{43} D^*(2010)^{\pm} D^*(2010)^{\mp} anything
                                                                                                                     [c] ( 1.2 \pm 0.4 )%
                                                                                                                                  (10 \quad ^{+11}_{-10} \quad )\%
\Gamma_{44} \overline{D} D anything
\Gamma_{45} D_2^*(2460)^0 anything
                                                                                                                                  (4.7 \pm 2.7)\%
\Gamma_{46} D_{s}^{-} anything
                                                                                                                                  (14.7 \pm 2.1)\%
\Gamma_{47} D_s^+ anything
                                                                                                                                  ( 10.1 \pm 3.1 ) %
\Gamma_{48} \Lambda_c^{\dagger} anything
                                                                                                                                  (7.7 \pm 1.1)\%
\Gamma_{49} = \overline{c}/c anything
                                                                                                                     [d] (116.2 \pm 3.2)\%
                                                                                 Charmonium modes
             J/\psi(1S) anything
\Gamma_{50}
                                                                                                                                  (1.16\pm~0.10)\%
                                                                                                                                  (3.06\pm 0.30)\times 10^{-3}
\Gamma_{51} \psi(2S) anything
            \chi_{c0}(1P) anything
                                                                                                                                  ( 1.5 \pm 0.6)%
             \chi_{c1}(1P) anything
                                                                                                                                  (1.4 \pm 0.4)\%
                                                                                                                                 (6.2 \pm 2.9) \times 10^{-3}
              \chi_{c2}(1P) anything
              \chi_c(2P) anything, \chi_c 	o \phi \phi
                                                                                                                                                                           \times 10^{-7}
                                                                                                                                                                                                     CL=95%
\Gamma_{56}
              \eta_c(1S) anything
                                                                                                                             (5.6 \pm 0.9) \times 10^{-3}
             \eta_{m{c}}(2S) anything, \ \eta_{m{c}} 
ightarrow \ \phi \, \phi
                                                                                                                                (3.9 \pm 1.4) \times 10^{-7}
                \chi_{c1}(3872) anything, \chi_{c1} \rightarrow \phi \phi
                                                                                                                              < 4.5
\Gamma_{58}
                                                                                                                                                                                                      CL=95%
                \chi_{c0}(3915) anything, \chi_{c0} \rightarrow \phi \phi
                                                                                                                                                                           \times 10^{-7}
                                                                                                                                          3.1
                                                                                                                                                                                                     CL=95%
                                                                                       K or K^* modes
                                                                                                                                  (3.1 \pm 1.1) \times 10^{-4}
\Gamma_{60}
              \overline{s}\gamma
\Gamma_{61} \overline{s} \overline{\nu} \nu
                                                                                                                                                                      \times 10^{-4}
                                                                                                                                                                                                     CL=90%
                                                                                                   B1
                                                                                                                               < 6.4
\Gamma_{62} K^{\pm} anything
                                                                                                                                  (74 \pm 6)\%
\Gamma_{63}^{02} K_{S}^{0} anything
                                                                                                                                  (29.0 \pm 2.9)\%
                                                                                             Pion modes
\Gamma_{64} \pi^{\pm} anything
                                                                                                                                  (397
                                                                                                                                                     \pm 21 )%
\Gamma_{65} \pi^0 anything
                                                                                                                     [d] (278 \pm 60)\%
\Gamma_{66} \phi anything
                                                                                                                                  (2.82 \pm 0.23)\%
                                                                                          Baryon modes
\Gamma_{67} p/\overline{p} anything
                                                                                                                                  ( 13.1 \pm 1.1 ) %
\Gamma_{68} \Lambda / \Lambdaanything
                                                                                                                                  (5.9 \pm 0.6)\%
            b-baryon anything
                                                                                                                                  (10.2 \pm 2.8)\%
\Gamma_{70} \overline{\Lambda}_{b}^{0} anything
\Gamma_{71} \Xi_h^+ anything
                                                                                            Other modes
\Gamma_{72} charged anything
                                                                                                                     [d] (497 \pm 7)\%
                                                                                                                                  ( 1.7 \buildrel + 1.0 \build
Γ<sub>73</sub> hadron<sup>+</sup> hadron<sup>-</sup>
                                                                                                                                  (7 \pm 21) \times 10^{-3}
\Gamma_{74} charmless
```

$\Delta B = 1$ weak neutral current (B1) modes

 Γ_{75} $e^+\,e^-$ anything $$\rm B1$$ < 3.2 $\times\,10^{-4}$ CL=90% Γ_{77} $\nu\,\overline{\nu}$ anything

- [a] An ℓ indicates an e or a μ mode, not a sum over these modes.
- [b] D_j represents an unresolved mixture of pseudoscalar and tensor D^{**} (P-wave) states.
- [c] The value is for the sum of the charge states or particle/antiparticle states indicated.
- [d] Inclusive branching fractions have a multiplicity definition and can be greater than 100%.

$B^{\pm}/B^{0}/B_{s}^{0}/b$ -baryon ADMIXTURE BRANCHING RATIOS

 $\Gamma(B^+)/\Gamma_{ ext{total}}$ Γ_1/Γ

"OUR EVALUATION" is an average from Z decay obtained by the Heavy Flavor Averaging Group (HFLAV) as described at https://hflav.web.cern.ch/.

VALUE DOCUMENT ID TECN COMMENT

0.408 \pm 0.007 OUR EVALUATION

1 ABDALLAH 03K DLPH $e^+e^- \rightarrow Z$

 $\Gamma(B^+)/\Gamma(B^0)$ VALUE

DOCUMENT ID

TECN
COMMENT

1.054 \pm 0.018 \pm 0.062

AALTONEN

OBN
CDF $p\overline{p}$ at 1.96 TeV

 $\Gamma(B_s^0)/\Gamma(B^+)$ Γ_3/Γ_1

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $^{^1}$ The analysis is based on a neural network, to estimate the charge of the weakly-decaying b hadron by distinguishing its decay products from particles produced at the primary

¹ AAIJ 20V measures the average value using the observed $B_s^0 \to J/\psi \phi$ and $B^+ \to J/\psi K^+$ yields, over the ranges *b*-hadron p_T of 0.5 and 40 GeV and η of 2.0 and 6.5. The value is not used in averages as BR-related systematic uncertainties are not evaluated.

² AAIJ 20V reports $[\Gamma(\overline{b} \to B_s^0)/\Gamma(\overline{b} \to B^+)] \times [B(B_s^0 \to J/\psi(1S)\phi)] / [B(B^+ \to J/\psi(1S)K^+)] = 0.1238 \pm 0.0010 \pm 0.0022$ which we multiply or divide by our best values $B(B_s^0 \to J/\psi(1S)\phi) = (1.04 \pm 0.04) \times 10^{-3}$, $B(B^+ \to J/\psi(1S)K^+) = (1.020 \pm 0.019) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

- 3 AAIJ 20V reports $[\Gamma(\overline{b} o B_s^0)/\Gamma(\overline{b} o B^+)] imes [B(B_s^0 o J/\psi(1S)\phi)] \ / \ [B(B^+ o B_s^+)] \ / \ [B(B_s^+ o B_s^+)] \ / \ [B(B_$ $J/\psi(1S)K^+)] = 0.1270 \pm 0.0007 \pm 0.0022$ which we multiply or divide by our best values B($B_S^0 \to J/\psi(1S)\phi$) = (1.04 ± 0.04) × 10⁻³, B($B^+ \to J/\psi(1S)K^+$) = $(1.020 \pm 0.019) \times 10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.
- ⁴ AAIJ 20V reports the results in two different data sets, and we quote here the weighted average.
- ⁵ AAIJ 20V reports $[\Gamma(\overline{b} \rightarrow B_S^0)/\Gamma(\overline{b} \rightarrow B^+)] \times [B(B_S^0 \rightarrow J/\psi(1S)\phi)] / [B(B^+ \rightarrow B_S^0)/\Gamma(\overline{b} \rightarrow B^+)]$ $J/\psi(1S)K^+)] = 0.1326 \pm 0.0007 \pm 0.0023$ which we multiply or divide by our best values $B(B_s^0 \to J/\psi(1S)\phi) = (1.04 \pm 0.04) \times 10^{-3}$, $B(B^+ \to J/\psi(1S)K^+) =$ $(1.020\pm0.019)\times10^{-3}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

Averaging Group (HFLAV) as described at https://hflav.web.cern.ch/.

<u>VALUE</u>	DOCUMENT ID	TECN	COMMENT				
0.1230±0.0115 OUR EVALUATION							
ullet $ullet$ We do not use the following	data for averages	s, fits, limits, e	etc. • • •				
0.122 ± 0.006	¹ AAIJ	19AD LHCB	pp at 13 TeV				
$0.134\ \pm0.004\ ^{+0.011}_{-0.010}$	² AAIJ	12J LHCB	pp at 7 TeV				
$0.1265 \pm 0.0085 \pm 0.0131$	³ AAIJ	11F LHCB	pp at 7 TeV				
$0.128 \ ^{+0.011}_{-0.010} \ \pm 0.011$	⁴ AALTONEN	08N CDF	$p\overline{p}$ at 1.96 TeV				
0.213 ± 0.068	⁵ AFFOLDER	00E CDF	$p\overline{p}$ at 1.8 TeV				
$\begin{array}{ccc} 0.21 & \pm 0.036 & ^{+0.038}_{-0.030} \end{array}$	⁶ ABE	99P CDF	$\overline{p}p$ at 1.8 TeV				
_							

 $^{^{}m 1}$ AAIJ $^{
m 19}$ AD measured the average value using $^{
m b}$ -hadron semileptonic decays and assuming isospin symmetry for b-hadron p_T of 4 and 25 GeV and η of 2 and 5.

 $\Gamma(B_s^0)/\Gamma(B^0)$ OUR EVALUATION" has been provided by the Heavy Flavor Averaging Group

(HFLAV, https://hflav.web.cern.ch/).

<u>VALUE</u>	<u>DOCUMENT ID</u>	TECN	COMMENT
0.246 ± 0.023 OUR EVALUATION			
0.239 ± 0.016 OUR AVERAGE			
	AAD	15CM ATLS	pp at 7 TeV
$0.238 \pm 0.004 \pm 0.026$	AAIJ	13P LHCB	pp at 7 TeV
https://pdg.lbl.gov	Page 8	Crea	ated: 6/1/2022 09:38

 $^{^2}$ AAIJ 12J measured this value using b-hadron semileptonic decays and assuming isospin symmetry.

 $^{^3}$ AAIJ 11F measured $f_s/f_d=0.253\pm0.017\pm0.017\pm0.020$, where the errors are statistical, systematic, and theoretical. We divide their value by 2. Our second error combines systematic and theoretical uncertainties.

⁴ AALTONEN 08N reports $[\Gamma(\overline{b} \to B_s^0)/[\Gamma(\overline{b} \to B^+) + \Gamma(\overline{b} \to B^0)]] \times [B(D_s^+ \to \phi\pi^+)] = (5.76 \pm 0.18^{+0.45}_{-0.42}) \times 10^{-3}$ which we divide by our best value $B(D_s^+ \to B^0)$ $\phi\pi^+)=(4.5\pm0.4) imes10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $^{^5}$ AFFOLDER 00E uses several electron-charm final states in $b\to c\,e^-$ X. 6 ABE 99P uses the numbers of $K^*(892)^0,~K^*(892)^+,~{\rm and}~\phi(1020)$ events produced in association with the double semileptonic decays $b o c\mu^- \mathsf{X}$ with $c o s\mu^+ \mathsf{X}$.

We do not use the following data for averages, fits, limits, etc.

0.2385 ± 0.0075	³ AAIJ	21Y LHCB	pp at 8 TeV
0.2539 ± 0.0079	³ AAIJ	21Y LHCB	pp at 13 TeV
0.2390 ± 0.0076	³ AAIJ	21Y LHCB	pp at 7 TeV

 1 AAD 15CM measurement is derived from the observed $B_s^0 o J/\psi \, \phi$ and $B_d^0 o J/\psi \, K^{*0}$ yields and a recent theory prediction of B($B^0_s \to J/\psi \phi$)/B($B^0_d \to J/\psi K^{*0}$). The second uncertainty combines in quadrature systematic and theoretical uncertainties. ² AAIJ 13P studies also separately the $p_T(B)$ and $\eta(B)$ dependency of $\Gamma(\overline{b} \to B^0_s)/\Gamma(\overline{b} \to B^0_s)$

 (B^0) , finding $f_s/f_d(p_T) = (0.256 \pm 0.020) + (-2.0 \pm 0.6) \ 10^{-3} \ / \text{GeV/c} \ (p_T - \langle p_T \rangle)$ and $f_{S}/f_{d}(\eta)$ = (0.256 \pm 0.020) + (0.005 \pm 0.006) (η – $\langle \eta \rangle$), where $\langle p_{T} \rangle$ = 10.4 GeV/c and $\langle \eta \rangle =$ 3.28. AAIJ 13P reports the measurement as 0.238 \pm 0.004 \pm 0.015 \pm 0.021 where the last uncertainly is theoretical.

³ AAIJ 21Y uses hadronic decays $B^0 o D^-\pi^+$, $B^0 o D^-K^+$, $B^0_s o D^-\pi^+$ and $B_s^0 \to J/\psi \phi$ as well as semileptonic B^0 and B_s^0 decays. Measured within the p_T range [0.5,40] GeV/c, η range [2, 6.4].

$\Gamma(B_s^+)/[\Gamma(B^+)+\Gamma(B^0)]$

 $\Gamma_4/(\Gamma_1+\Gamma_2)$

$VALUE$ (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
3.7 ±0.6 OUR AVERAGE	•			
$3.63 \pm 0.08 \pm 0.87$	1 AAIJ	19AI	LHCB	pp at 7 TeV
$3.78\pm0.04\pm0.90$	1 AAIJ	19AI	LHCB	pp at 13 TeV

¹ Measured using B_c^+ semileptonic decays.

 $\Gamma(b ext{-baryon})/[\Gamma(B^+)+\Gamma(B^0)]$ $\Gamma_5/(\Gamma_1+\Gamma_2)$ "OUR EVALUATION" is an average from Z decay obtained by the Heavy Flavor Averaging Group (HFLAV) as described at https://hflav.web.cern.ch/.

TECN COMMENT

Created: 6/1/2022 09:38

VALUE DOCUMENT ID 0.103 ± 0.015 OUR EVALUATION

We do not use the following data for averages, fits, limits, etc.

		-,,, .	
0.259 ± 0.018	¹ AAIJ	19AD LHCB	pp at 13 TeV
$0.305 \pm 0.010 \pm 0.081$	² AAIJ	12J LHCB	pp at 7 TeV
$0.31 \ \pm 0.11 \ ^{+0.12}_{-0.08}$	³ AALTONEN	09E CDF	$p\overline{p}$ at $1.8~{ m TeV}$
$0.22 \ ^{+0.08}_{-0.07} \ \pm 0.01$	⁴ AALTONEN	08N CDF	$p\overline{p}$ at 1.96 TeV
0.118 ± 0.042	^{3,5} AFFOLDER	00E CDF	p at 1.8 TeV

 $^{^1}$ AAIJ 19AD measured the average value for \varLambda_b^0 using semileptonic decays and assuming isospin symmetry for $b\text{-hadron}~p_T$ of 4 and 25 GeV and η of 2 and 5.

 $^{^2}$ AAIJ 12J measured the ratio to be (0.404 \pm 0.017 \pm 0.027 \pm 0.105) \times [1 - (0.031 \pm $0.004\pm0.003)\times P_T]$ using b-hadron semileptonic decays where the P_T is the momentum of charmed hadron-muon pair in GeV/c.We quote their weighted average value where the second error combines systematic and the error on B($\Lambda_c^+ \to pK^-\pi^+$).

 $^{^3}$ AALTONEN 09E errata to the measurement reported in AFFOLDER 00E using the $ho_{\mathcal{T}}$ spectra from fully reconstructed B^0 and Λ_b decays.

⁴ AALTONEN 08N reports $[\Gamma(\overline{b} \rightarrow b\text{-baryon})/[\Gamma(\overline{b} \rightarrow B^+) + \Gamma(\overline{b} \rightarrow B^0)]] \times [B(\Lambda_c^+ \rightarrow b^+)]$ $pK^-\pi^+)]=(14.1\pm0.6^{+5.3}_{-4.4})\times10^{-3}$ which we divide by our best value B($\Lambda_C^+\to$ $pK^-\pi^+$) = $(6.28 \pm 0.32) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $^{^{5}}$ AFFOLDER 00E uses several electron-charm final states in $b
ightarrow c \, e^{-}$ X.

 $\Gamma(\nu \text{ anything})/\Gamma_{\text{total}}$ VALUE0.2308±0.0077±0.0124 $I_{1,2}$ ACCIARRI 96C L3 $I_{2,4}$ ACCIARRI 96C L3 $I_{3,4}$ ACCIARRI 96C L3

$\Gamma(\ell^+\nu_\ell \text{ anything})/\Gamma_{\text{total}}$

 Γ_7/Γ

"OUR EVALUATION" is an average of the data listed below, excluding all asymmetry measurements, performed by the LEP Electroweak Working Group as described in the "Note on the Z boson" in the Z Particle Listings.

VALUE	DOCUMENT ID		TECN	COMMENT
0.1069±0.0022 OUR EVALUATIO)N			
0.1064±0.0016 OUR AVERAGE				
$0.1070 \pm 0.0010 \pm 0.0035$	$^{ m 1}$ HEISTER	02 G	ALEP	$e^+e^- ightarrow Z$
$0.1070 \pm 0.0008 {}^{+ 0.0037}_{- 0.0049}$	² ABREU	01L	DLPH	$e^+e^- ightarrow Z$
$0.1083\!\pm\!0.0010\!+\!0.0028\\-0.0024$	³ ABBIENDI	00E	OPAL	$e^+e^- ightarrow Z$
$0.1016 \pm 0.0013 \pm 0.0030$	⁴ ACCIARRI	00		$e^+e^- ightarrow Z$
$0.1085 \pm 0.0012 \pm 0.0047$	^{5,6} ACCIARRI	96 C	L3	$e^+e^- ightarrow Z$
• • • We do not use the following	data for averages	, fits,	limits, e	etc. • • •
$0.1106 \pm 0.0039 \pm 0.0022$	⁷ ABREU	95 D	DLPH	$e^+e^- ightarrow Z$
$0.114\ \pm0.003\ \pm0.004$	⁸ BUSKULIC	94 G	ALEP	$e^+e^- ightarrow Z$
$0.100 \pm 0.007 \pm 0.007$	⁹ ABREU	93 C	DLPH	$e^+e^- ightarrow Z$
$0.105 \pm 0.006 \pm 0.005$	¹⁰ AKERS	93 B	OPAL	Repl. by ABBI- ENDI 00E

¹ Uses the combination of lepton transverse momentum spectrum and the correlation between the charge of the lepton and opposite jet charge. The first error is statistic and the second error is the total systematic error including the modeling.

¹ ACCIARRI 96C assumes relative b semileptonic decay rates $e:\mu:\tau$ of 1:1:0.25. Based on missing-energy spectrum.

 $^{^2}$ Assumes Standard Model value for R_B .

² The experimental systematic and model uncertainties are combined in quadrature.

³ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \rightarrow b \overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error.

⁴ ACCIARRI 00 result obtained from a combined fit of $R_b = \Gamma(Z \to b\overline{b})/\Gamma(Z \to \text{hadrons})$ and B($b \to \ell \nu X$), using double-tagging method.

 $^{^{5}}$ ACCIARRI 96C result obtained by a fit to the single lepton spectrum.

 $^{^6}$ Assumes Standard Model value for R_B .

 $^{^7}$ ABREU 95D give systematic errors ± 0.0019 (model) and 0.0012 (R_c). We combine these in quadrature.

⁸ BUSKULIC 94G uses e and μ events. This value is from a global fit to the lepton p and p_T (relative to jet) spectra which also determines the b and c production fractions, the fragmentation functions, and the forward-backward asymmetries. This branching ratio depends primarily on the ratio of dileptons to single leptons at high p_T , but the lower p_T portion of the lepton spectrum is included in the global fit to reduce the model dependence. The model dependence is ± 0.0026 and is included in the systematic error.

⁹ ABREU 93C event count includes ee events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100\pm0.007\pm0.007$.

 $^{^{}m 10}$ AKERS 93B analysis performed using single and dilepton events.

$\Gamma(e^+\nu_e$ anything)/ Γ_{to}	tal					Γ_8/Γ
VALUE	EVTS	DOCUMENT ID		TECN	COMMENT	
0.1086±0.0035 OUR AVE	RAGE					
$0.1078 \pm 0.0008 {+0.0050 \atop -0.0046}$		¹ ABBIENDI	00E	OPAL	$e^+e^- ightarrow Z$	
$0.1089 \pm 0.0020 \pm 0.0051$		^{2,3} ACCIARRI	96C	L3	$e^+e^- ightarrow~Z$	
$0.107 \ \pm 0.015 \ \pm 0.007$	260	⁴ ABREU	93 C	DLPH	$e^+e^- ightarrow Z$	
$0.138 \pm 0.032 \pm 0.008$		⁵ ADEVA	91 C	L3	$e^+e^- ightarrow~Z$	
• • • We do not use the	following	data for averages,	fits, li	mits, etc	5. ● ● ●	
$0.086\ \pm0.027\ \pm0.008$		⁶ ABE	93E	VNS	$E_{\mathrm{cm}}^{\mathrm{ee}} = 58 \; \mathrm{GeV}$	
$0.109 {}^{+ 0.014}_{- 0.013} \pm 0.0055$	2719	⁷ AKERS	93 B	OPAL	Repl. by ABBI- ENDI 00E	
$0.111 \ \pm 0.028 \ \pm 0.026$		BEHREND	90 D	CELL	$E_{\rm cm}^{ee} = 43 \; {\rm GeV}$	
$0.150\ \pm0.011\ \pm0.022$		BEHREND	90 D	CELL	$E_{\rm cm}^{ee} = 35 {\rm GeV}$	
$0.112\ \pm0.009\ \pm0.011$		ONG	88	MRK2	$E_{ m cm}^{ m ee} = 29 \; { m GeV}$	
$0.149 \begin{array}{l} +0.022 \\ -0.019 \end{array}$		PAL	86	DLCO	$E_{ m cm}^{ m ee}=$ 29 GeV	
$0.110\ \pm0.018\ \pm0.010$		AIHARA	85	TPC	$E_{\rm cm}^{ee} = 29 \; {\rm GeV}$	
$0.111 \pm 0.034 \pm 0.040$		ALTHOFF	84J	TASS	Eee 34.6 Ge	/
0.146 ± 0.028		KOOP	84	DLCO	Repl. by PAL 8	6
$0.116\ \pm0.021\ \pm0.017$		NELSON	83	MRK2	$E_{\rm cm}^{\it ee}$ = 29 GeV	

 $^{^{}m 1}$ ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \to b \overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error. ² ACCIARRI 96C result obtained by a fit to the single lepton spectrum.

⁷ AKERS 93B analysis performed using single and dilepton events.

$\Gamma(\mu^+ u_\mu$ anything)/ $\Gamma_{ ext{total}}$						
VALUE	EVTS	DOCUMENT ID		TECN	COMMENT	
$0.1095^{+0.0029}_{-0.0025}$ OUR AV	ERAGE					
$0.1096\!\pm\!0.0008\!+\!0.0034\\-0.0027$		¹ ABBIENDI	00E	OPAL	$e^+e^- ightarrow Z$	
$\begin{array}{c} 0.1082 \!\pm\! 0.0015 \!\pm\! 0.0059 \\ 0.110 \ \pm\! 0.012 \ \pm\! 0.007 \\ 0.113 \ \pm\! 0.012 \ \pm\! 0.006 \end{array}$	656	^{2,3} ACCIARRI ⁴ ABREU ⁵ ADEVA	93C	DLPH	$e^+e^- \rightarrow Z$ $e^+e^- \rightarrow Z$ $e^+e^- \rightarrow Z$	

 $^{^3}$ Assumes Standard Model value for R_B .

⁴ABREU 93C event count includes ee events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100 \pm 0.007 \pm 0.007$.

The state of the tagged b enhanced Z events. Combining e and μ results, they obtain $0.113 \pm 0.010 \pm 0.006$. Constraining the initial number of b_quarks by the Standard Model prediction (378 \pm 3 MeV) for the decay of the Z into $b\overline{b}$, the electron result gives $0.112 \pm 0.004 \pm 0.004$ 0.008. They obtain $0.119 \pm 0.003 \pm 0.006$ when e and μ results are combined. Used to measure the $b\overline{b}$ width itself, this electron result gives $370 \pm 12 \pm 24$ MeV and combined with the muon result gives 385 \pm 7 \pm 22 MeV.

⁶ ABE 93E experiment also measures forward-backward asymmetries and fragmentation functions for b and c.

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.122 ± 0.00	06 ± 0.007		³ UENO	96	AMY	e^+e^- at 57.9 GeV
$0.101 \begin{array}{c} +0.0 \\ -0.0 \end{array}$	$^{10}_{09}$ ± 0.0055	4248	⁶ AKERS	93 B	OPAL	Repl. by ABBI- ENDI 00E
0.104 ± 0.03	23 ± 0.016		BEHREND	90 D	CELL	$E_{\rm cm}^{ee} = 43 \text{ GeV}$
0.148 ± 0.0	10 ± 0.016		BEHREND	90 D	CELL	$E_{\mathrm{cm}}^{\mathrm{ee}} = 35 \; \mathrm{GeV}$
0.118 ± 0.0	12 ± 0.010		ONG	88	MRK2	$E_{ m cm}^{ m ee} = 29 \; { m GeV}$
0.117 ± 0.0	16 ± 0.015		BARTEL	87	JADE	<i>E</i> ^{ee} _{cm} = 34.6 GeV
0.114 ± 0.0	18 ± 0.025		BARTEL	85J	JADE	Repl. by BARTEL 87
0.117 ± 0.09	28 ± 0.010		ALTHOFF	84G	TASS	$E_{\rm cm}^{\rm ee}=34.5~{\rm GeV}$
0.105 ± 0.0	15 ± 0.013		ADEVA	83 B	MRKJ	E ^{ee} _{cm} = 33–38.5 GeV
$0.155 \begin{array}{c} +0.05 \\ -0.05 \end{array}$	54 29		FERNANDEZ	83 D	MAC	Eee = 29 GeV

 $^{^{}m 1}$ ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \rightarrow b\overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic

$\Gamma(D^-\ell^+\nu_\ell)$ anything $\Gamma(D^-\ell^+\nu_\ell)$

 Γ_{10}/Γ

		10/
DOCUMENT ID	TECN COMMENT	
Error includes scale fa	ctor of 1.9.	
¹ ABREU 00R	DLPH $e^+e^- \rightarrow Z$	
² AKERS 95Q	OPAL $e^+e^- o Z$	
	Error includes scale fa	Error includes scale factor of 1.9. ¹ ABREU 00R DLPH $e^+e^- \rightarrow Z$

 $^{^1}$ ABREU 00R reports their experiment's uncertainties $\pm 0.0019 \pm 0.0016 \pm 0.0018$, where the first error is statistical, the second is systematic, and the third is the uncertainty due to the ${\it D}$ branching fraction. We combine first two in quadrature.

² AKERS 95Q reports $[\Gamma(\overline{b} \to D^- \ell^+ \nu_\ell \text{ anything})/\Gamma_{\text{total}}] \times [B(D^+ \to K^- 2\pi^+)] = (1.82 \pm 0.20 \pm 0.12) \times 10^{-3}$ which we divide by our best value $B(D^+ \to K^- 2\pi^+) = 0.00$ $(9.38 \pm 0.16) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(D^-\pi^+\ell^+ u_\ell$ anything)/ $\Gamma_{ ext{total}}$						
VALUE	DOCUMENT ID		TECN	COMMENT		
$0.0049 \pm 0.0018 \pm 0.0007$	ABREU	00 R	DLPH	$e^+e^- ightarrow Z$		
$\Gamma(D^-\pi^-\ell^+ u_\ell$ anything $)/\Gamma_{ m tota}$	al				Γ_{12}/Γ	
VALUE	DOCUMENT ID		TECN	COMMENT		
$0.0026 \pm 0.0015 \pm 0.0004$	ABREU	00 R	DLPH	$e^+e^- ightarrow~Z$		

error. $^2\,\mathrm{ACCIARRI}$ 96C result obtained by a fit to the single lepton spectrum. $^-$

 $^{^3}$ Assumes Standard Model value for R_B .

⁴ ABREU 93C event count includes $\mu\mu$ events. Combining ee, $\mu\mu$, and $e\mu$ events, they obtain $0.100 \pm 0.007 \pm 0.007$.

 $^{^{5}}$ ADEVA 91C measure the average B(b o eX) branching ratio using single and double tagged b enhanced Z events. Combining e and μ results, they obtain 0.113 \pm 0.010 \pm 0.006. Constraining the initial number of b quarks by the Standard Model prediction $(378\pm3 \text{ MeV})$ for the decay of the Z into $b\overline{b}$, the muon result gives $0.123\pm0.003\pm0.006$. They obtain $0.119 \pm 0.003 \pm 0.006$ when e and μ results are combined. Used to measure the $b\overline{b}$ width itself, this muon result gives 394 \pm 9 \pm 22 MeV and combined with the electron result gives 385 \pm 7 \pm 22 MeV.

⁶ AKERS 93B analysis performed using single and dilepton events.

$\Gamma(\overline{D}^0\ell^+\nu_\ell \text{ anything})/\Gamma_{\text{total}}$					Γ ₁₃ /Γ
VALUE	DOCUMENT IL)	TECN	COMMENT	
0.0679 ± 0.0034 OUR AVERAGE	1				
$0.0704 \pm 0.0040 \pm 0.0017$	¹ ABREU ² AKFRS			$e^+e^- ightarrow$	
$0.0638 \pm 0.0056 \pm 0.0005$, t to	•		$e^+e^- \rightarrow$	
¹ ABREU 00R reports their exp the first error is statistical, the to the <i>D</i> branching fraction. ² AKERS 95Q reports $[\Gamma(\overline{b} \rightarrow (2.52 \pm 0.14 \pm 0.17) \times 10^{-3} (3.947 \pm 0.030) \times 10^{-2}]$. Ou	e second is systen We combine first $\overline{D}^0 \ell^+ \nu_\ell$ anyth which we divide r first error is their	natic, a two in ing)/Γ _t by our ir exper	nd the tl quadrati total] × best va	nird is the ur ure. $[B(D^0 ightarrow $ lue $B(D^0 ightarrow $	$(K^-\pi^+)$] = $(K^-\pi^+)$ =
is the systematic error from u	ısing our best valı	ıe.			
$\Gamma(\overline{D}{}^0\pi^-\ell^+ u_\ell$ anything)/ Γ_{to}	tal				Γ_{14}/Γ
<u>VALUE</u>	DOCUMENT IL)	TECN	COMMENT	
$0.0107 \pm 0.0025 \pm 0.0011$	ABREU	00 R	DLPH	$e^+e^- \rightarrow$	Z
[[]0 -+ (+ -, -n, +b;n=) /[F /F
$\Gamma(\overline{D}{}^0\pi^+\ell^+\nu_\ell$ anything)/ Γ_{to}		`	TECN	COMMENT	Γ ₁₅ /Γ
<u>VALUE</u> 0.0023±0.0015±0.0004	<u>DOCUMENT IL</u> ABREU			$\frac{COMMENT}{e^+e^-} \rightarrow$	
0.0023±0.0013±0.0004	ADREU	UUR	DLPH	e ' e →	_
$\Gamma(D^{*-}\ell^+\nu_\ell \text{ anything})/\Gamma_{\text{tota}}$	I				Γ ₁₆ /Γ
VALUE	DOCUMENT IL)	TECN	COMMENT	
0.0275±0.0019 OUR AVERAGE	1			1	_
$0.0275 \pm 0.0021 \pm 0.0009$	¹ ABREU			$e^+e^- ightarrow$	
$0.0276 \pm 0.0027 \pm 0.0011$	² AKERS	•		$e^+e^- \rightarrow$	
¹ ABREU 00R reports their exp the first error is statistical, the to the D branching fraction. ² AKERS 95Q reports $[B(\overline{b} \rightarrow (7.53 \pm 0.47 \pm 0.56) \times 1)]$ $B(D^0 \rightarrow K^-\pi^+) = 0.0401$ experiments error and the se	e second is systen We combine first $D^*\ell^+ u_\ell X) imes B$ 0^{-4}) and uses B \pm 0.0014 to obta	natic, and two in $(D^{*+} - D^{*+})$ ain the (D^{*+})	nd the tl quadrati $ ightarrow ~D^0 \pi^0$ $ ightarrow ~D^0 \pi^0$ above re	nird is the urure. $^{+}) imes B(D^{0})$ $^{-+}) = 0.681$ sult. The fir	ocertainty due $ o \ \mathcal{K}^-\pi^+)] \ \pm 0.013$ and st error is the
branching ratios.					
$\Gamma(D^{*-}\pi^-\ell^+\nu_\ell \text{ anything})/\Gamma$	total				Γ ₁₇ /Γ
VALUE	DOCUMENT II				
$0.0006 \pm 0.0007 \pm 0.0002$	ABREU	00 R	DLPH	$e^+e^- \rightarrow$	Z
$\Gamma(D^{*-}\pi^+\ell^+\nu_\ell \text{ anything})/\Gamma_\ell$	total				Γ ₁₈ /Γ
VALUE	DOCUMENT II				
$0.0048 \pm 0.0009 \pm 0.0005$	ABREU	00 R	DLPH	$e^+e^- \rightarrow$	Z
$\Gamma(\overline{D}_i^0\ell^+\nu_\ell)$ anything \times B(\overline{D}_i^0	$\rightarrow D^{*+}\pi^{-}))/$	Γ _{total}			Γ ₁₉ /Γ
D_i represents an unresolved	-		r and ter	nsor <i>D**</i> (<i>P</i> -	wave) states
VALUE (units 10^{-3})	DOCUMENT ID				
2.64±0.79±0.39	ABBIENDI				
• • • We do not use the following					
6.1 $\pm 1.3 \pm 1.3$				epl. by ABB	IENDI 03M
https://pdg.lbl.gov	Page 13		Crea	ated: 6/1/	2022 09:38

$\Gamma(D_i^-\ell^+\nu_\ell \text{ anything} \times \mathsf{B}(D_i^- \to D^0\pi^-))/\Gamma_{\mathsf{total}}$

 Γ_{20}/Γ

 D_i represents an unresolved mixture of pseudoscalar and tensor D^{**} (P-wave) states.

VALUE (units 10^{-3})	DOCUMENT ID		TECN	COMMENT
$7.0\pm1.9^{+1.2}_{-1.3}$	AKERS	95Q	OPAL	$e^+e^- \rightarrow Z$

$$\Gamma(\overline{D_2^*(2460)^0}\ell^+\nu_\ell \text{ anything} \times B(\overline{D_2^*(2460)^0} \to D^{*-}\pi^+))/\Gamma_{\text{total}} \qquad \Gamma_{21}/\Gamma_{\text{VALUE (units }10^{-3})} \qquad \underline{CL\%} \qquad \underline{DOCUMENT\ ID} \qquad \underline{TECN} \qquad \underline{COMMENT}$$

<1.4
90
ABBIENDI
03M
OPAL
$$e^+e^- o Z$$

$$\Gamma(D_2^*(2460)^-\ell^+\nu_\ell \text{ anything} \times B(D_2^*(2460)^- \to D^0\pi^-))/\Gamma_{\text{total}}$$

$$\Gamma_{22}/\Gamma_{\text{VALUE (units }10^{-3})}$$

$$DOCUMENT ID$$

$$TECN$$

$$COMMENT$$

$$4.2\pm1.3^{+0.7}_{-1.2}$$

$$AKERS$$

$$95Q$$

$$OPAL$$

$$e^+e^- \to Z$$

$$\Gamma(\overline{D}_2^*(2460)^0 \ell^+ \nu_\ell \text{ anything} \times B(\overline{D}_2^*(2460)^0 \rightarrow D^- \pi^+))/\Gamma_{\text{total}}$$
 Γ_{23}/Γ_{23}

VALUE (units 10^{-3})	$.UE ext{ (units } 10^{-3})$ DOCUMENT ID		TECN	COMMENT
1.6±0.7±0.3	AKERS	950	OPAL	$e^+e^- \rightarrow Z$

AKERS

$\Gamma(\text{charmless } \ell \overline{\nu}_{\ell}) / \Gamma_{\text{total}}$

 Γ_{24}/Γ

"OUR EVALUATION" is an average of the data listed below performed by the LEP Heavy Flavour Steering Group. The averaging procedure takes into account correlations between the measurements.

<u>VALUE</u>	<u>DOCUMENT ID</u>		TECN	COMMENT
0.00171±0.00052 OUR EVALUAT				
0.0017 ± 0.0004 OUR AVERAGE	•			
$0.00163\!\pm\!0.00053\!+\!0.00055\\-0.00062$	¹ ABBIENDI	01 R	OPAL	$e^+e^- ightarrow Z$
$0.00157 \pm 0.00035 \pm 0.00055$	² ABREU	00 D	DLPH	$e^+e^- ightarrow Z$
$0.00173 \pm 0.00055 \pm 0.00055$	³ BARATE	99G	ALEP	$e^+e^- ightarrow~Z$

⁴ ACCIARRI

98K L3

$\Gamma(\tau^+\nu_{\tau} \text{ anything})/\Gamma_{\text{total}}$

 $0.0033 \pm 0.0010 \pm 0.0017$

 Γ_{25}/Γ

VALUE (units 10^{-2})	EVTS	DOCUMENT ID		TECN	COMMENT
2.41±0.23 OUR AVER	AGE				
$2.78\!\pm\!0.18\!\pm\!0.51$		$^{ m 1}$ ABBIENDI	01 Q	OPAL	$e^+e^- ightarrow Z$
$2.43\!\pm\!0.20\!\pm\!0.25$		² BARATE	01E	ALEP	$e^+e^- ightarrow Z$
$2.19\!\pm\!0.24\!\pm\!0.39$		³ ABREU	00 C	DLPH	$e^+e^- ightarrow Z$
$1.7 \pm 0.5 \pm 1.1$		^{4,5} ACCIARRI	96C	L3	$e^+e^- ightarrow Z$
$2.4 \pm 0.7 \pm 0.8$	1032	⁶ ACCIARRI	94C	L3	$e^+e^- ightarrow Z$

 $^{^1}$ Obtained from the best fit of the MC simulated events to the data based on the b
ightarrow $X_{\mu}\ell\nu$ neutral network output distributions.

 $^{^2}$ ABREU 00D result obtained from a fit to the numbers of decays in b
ightarrow u enriched and depleted samples and their lepton spectra, and assuming $|V_{CB}| = 0.0384 \pm 0.0033$ and $au_b = 1.564 \pm 0.014 \ \mathrm{ps}.$

 $^{^3}$ Uses lifetime tagged $b\overline{b}$ sample.

 $^{^4}$ ACCIARRI 98K assumes $R_b =$ 0.2174 \pm 0.0009 at Z decay.

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $2.75\pm0.30\pm0.37$ 405 7 BUSKULIC 95 ALEP Repl. by BARATE 01E $4.08\pm0.76\pm0.62$ BUSKULIC 93B ALEP Repl. by BUSKULIC 95

$\Gamma(\overline{b} ightarrow \overline{c} ightarrow \ell^- \overline{ u}_\ell$ anything)/ Γ_{total}

 Γ_{27}/Γ

Created: 6/1/2022 09:38

"OUR EVALUATION" is an average of the data listed below, excluding all asymmetry measurements, performed by the LEP Electroweak Working Group as described in the "Note on the Z boson" in the Z Particle Listings.

VALUE	DOCUMENT ID		TECN	COMMENT
0.0802 ± 0.0019 OUR EVALUATIO	N			
0.0817±0.0020 OUR AVERAGE				
$0.0818 \!\pm\! 0.0015 \!+\! 0.0024 \\ -0.0026$	¹ HEISTER	02G	ALEP	$e^+e^- ightarrow Z$
$0.0798 \!\pm\! 0.0022 \!+\! 0.0025 \\ -0.0029$	² ABREU	01L	DLPH	$e^+e^- ightarrow Z$
$0.0840 \pm 0.0016 {}^{+ 0.0039}_{- 0.0036}$	³ ABBIENDI	00E	OPAL	$e^+e^- ightarrow Z$
• • • We do not use the following	data for averages	, fits,	limits, e	tc. • • •
$0.0770\pm0.0097\pm0.0046$				$e^+e^- ightarrow~Z$
$0.082\ \pm0.003\ \pm0.012$	⁵ BUSKULIC	94G	ALEP	$e^+e^- ightarrow Z$
$0.077 \pm 0.004 \pm 0.007$	⁶ AKERS	93 B	OPAL	Repl. by ABBI- FNDI 00F

¹ Uses the combination of lepton transverse momentum spectrum and the correlation between the charge of the lepton and opposite jet charge. The first error is statistic and the second error is the total systematic error including the modeling.

¹ABBIENDI 01Q uses a missing energy technique.

² The energy-flow and *b*-tagging algorithms were used.

³ Uses the missing energy in $Z \rightarrow b\overline{b}$ decays without identifying leptons.

⁴ ACCIARRI 96C result obtained from missing energy spectrum.

 $^{^{5}}$ Assumes Standard Model value for R_{B} .

⁶ This is a direct result using tagged $b\overline{b}$ events at the Z, but species are not separated.

⁷ BUSKULIC 95 uses missing-energy technique.

 $^{^{1}}$ The energy-flow and b-tagging algorithms were used.

 $^{^2}$ The experimental systematic and model uncertainties are combined in quadrature.

³ ABBIENDI 00E result is determined by comparing the distribution of several kinematic variables of leptonic events in a lifetime tagged $Z \rightarrow b\overline{b}$ sample using artificial neural network techniques. The first error is statistic; the second error is the total systematic error.

⁴ ABREU 95D give systematic errors ± 0.0033 (model) and 0.0032 (R_c). We combine these in quadrature. This result is from the same global fit as their $\Gamma(\overline{b} \to \ell^+ \nu_\ell X)$

data. 5 BUSKULIC 94G uses e and μ events. This value is from the same global fit as their $\Gamma(\overline{b} \to \ell^+ \nu_\ell \, {\rm anything})/\Gamma_{\rm total}$ data.

⁶ AKERS 93B analysis performed using single and dilepton events.

$\Gamma(c ightarrow \ell^+ u$ anything)/ $\Gamma_{ m total}$					Γ_{28}/Γ
VALUE	DOCUMENT ID		TECN	COMMENT	
$0.0161 \pm 0.0020 {+0.0034 \atop -0.0047}$	¹ ABREU	01 L	DLPH	$e^+e^- ightarrow Z$	

¹ The experimental systematic and model uncertainties are combined in quadrature.

 $\Gamma(\overline{D}^0 \text{ anything})/\Gamma_{\text{total}}$ VALUE DOCUMENT ID 1 BUSKULIC 1 BUSKULIC 2 BUSKULIC $2 \text{ BUSKUL$

 $\frac{\Gamma(D^{\mp}D_s^{\pm} \text{ anything})/\Gamma_{\text{total}}}{\text{VALUE}} \qquad \frac{DOCUMENT ID}{\text{DOCUMENT ID}} \qquad \frac{TECN}{\text{COMMENT}}$ $0.040_{-0.014}^{+0.017} + 0.011 \qquad ^{1} \text{ BARATE} \qquad 98Q \quad \text{ALEP} \quad e^{+}e^{-} \rightarrow Z$

 $\Gamma(\overline{D}^0D^0 ext{ anything})/\Gamma_{ ext{total}}$ $ext{DOCUMENT ID}$ $ext{TECN}$ $ext{COMMENT}$ $ext{COMMENT}$ $ext{0.051} + 0.016 + 0.012 + 0.011$ $ext{1}$ BARATE 98Q ALEP $e^+e^- oremsize Z$

 $\frac{\left[\Gamma(\overline{D}^0 D^0 \text{ anything}) + \Gamma(D^0 D^{\pm} \text{ anything})\right]/\Gamma_{\text{total}}}{\frac{DOCUMENT\ ID}{0.078 + 0.020 + 0.018}} \frac{\Gamma_{32} + \Gamma_{33}}{\frac{DOCUMENT\ ID}{0.078 + 0.018}} \frac{\Gamma_{32} + \Gamma_{33}}{\frac{DOCUMENT\ ID}{0.078$

 $^{^{1}}$ BUSKULIC 96Y reports 0.605 \pm 0.024 \pm 0.016 from a measurement of $[\Gamma(\overline{b}\to \overline{D}{}^{0}\,\text{anything})/\Gamma_{\text{total}}]\times [B(D^{0}\to K^{-}\pi^{+})]$ assuming $B(D^{0}\to K^{-}\pi^{+})=0.0383$, which we rescale to our best value $B(D^{0}\to K^{-}\pi^{+})=(3.947\pm0.030)\times10^{-2}.$ Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $^{^{}m 1}$ The systematic error includes the uncertainties due to the charm branching ratios.

 $^{^{}m 1}$ The systematic error includes the uncertainties due to the charm branching ratios.

¹ The systematic error includes the uncertainties due to the charm branching ratios.

 $^{^{}m 1}$ The systematic error includes the uncertainties due to the charm branching ratios.

 $^{^{1}}$ The systematic error includes the uncertainties due to the charm branching ratios.

¹ The systematic error includes the uncertainties due to the charm branching ratios.

$\Gamma(D^{\pm}D^{\mp}$ anythi	$\log)/\Gamma_{\rm total}$					Г ₃₄ /Г
VALUE	<u>CL%</u>	DOCUMENT ID		TECN	COMMENT	
<0.009	90	BARATE	98Q	ALEP	$e^+e^- ightarrow Z$	
$[\Gamma(D^0 \text{ anything})]$	$+\Gamma(D^+)$ any	thing)]/ Γ_{total}		TECN	, 55	+Γ ₃₆)/Γ
0.093±0.017±0.0	 14	¹ ABDALLAH				
	or is the total of	systematic uncer				g fractions
$\Gamma(D^- \text{ anything})$	$/\Gamma_{ m total}$	DOCUMENT ID		TECN	COMMENT	Γ ₃₇ /Γ
<u>VALUE</u>	04	DOCUMENT ID BUSKULIC				
D^- anything)/ which we resca	For the first O.23 $\Gamma_{\text{total}} \times [\text{B}(D)]$ le to our best veir experiment's	4 \pm 0.013 \pm 0.0 \pm 0.0 \pm 0.1	$010~{ m fr}$ assum $(-2\pi^{-1})$	from a ring $B(D^+) = (9)$	measurement of $^+ \rightarrow ~ {\it K}^- 2 \pi^+$.38 $\pm~ 0.16) imes 1$	$0 = 0.091,$ 0^{-2} . Our
Γ(<i>D</i> *(2010) ⁺ ar	$(\mathbf{r}_{tot})/\Gamma_{tot}$			TECN	<u>COMMENT</u>	Г ₃₈ /Г
0.173±0.016±0.0	12	¹ ACKERSTAFF				
¹ Uses lepton tag						
$\Gamma(D_1(2420)^0$ any VALUE	ything)/Γ _{total}			<u>TECN</u>	<u>COMMENT</u>	Г ₃₉ /Г
$0.050\pm0.014\pm0.0$	06	¹ ACKERSTAFF	97W	OPAL	$e^+e^- ightarrow Z$	
	97W assumes $= 0.216$ at Z	$B(D_2^*(2460)^0)$ decay.	\rightarrow	$D^{*+}\pi^{-}$	·) = 0.21 ±	0.04 and
Γ(D *(2010) [∓] D _{VALUE}	$\frac{\pm}{s}$ anything)/	total DOCUMENT ID		<u>TECN</u>	<u>COMMENT</u>	Γ ₄₀ /Γ
$0.033^{+0.010}_{-0.009}^{+0.0}_{-0.0}$	12 00	¹ BARATE	98Q	ALEP	$e^+e^- ightarrow Z$	
		the uncertainties (due to	the cha	rm branching ra	itios.
$\Gamma(D^0D^*(2010)^{-1})$						Γ ₄₁ /Γ
0.030 + 0.009 + 0.0 0.030 - 0.008 - 0.0	07 05	¹ BARATE				
2.000		the uncertainties (due to	the cha	rm branching ra	itios.
$\Gamma(D^*(2010)^{\pm}D_{VALUE})$	\mp anything $)/$			TECN	<u>COMMENT</u>	Γ ₄₂ /Γ
$0.025^{+0.010}_{-0.009}^{+0.010}_{-0.0}$	06 05	¹ BARATE				
		the uncertainties (due to	the cha	rm branching ra	itios.

$\Gamma(D^*(2010)^{\pm}D^*(2010)^{\mp})$ VALUE	dilytillig)/ total 		TECN	COMMENT	
	¹ BARATE				
¹ The systematic error include	des the uncertainties	due to	the cha	rm branching	g ratios.
$\Gamma(\overline{D}D$ anything) $/\Gamma_{total}$					Γ_{44}/Γ
VALUE	<u>DOCUMENT ID</u>				
$0.10 \pm 0.032 ^{+0.107}_{-0.095}$	¹ ABBIENDI	041	OPAL	$e^+e^- \rightarrow$	Z
Measurement performed under dates.	sing an inclusive iden	tificati	on of <i>B</i>	mesons and	the D candi-
$\Gamma(D_2^*(2460)^0 \text{ anything})/\Gamma(D_2^*(2460)^0 \text{ anything})$	total				Γ ₄₅ /Γ
VΔI IIE	DOCUMENT ID		<u>TECN</u>	COMMENT	
$0.047 \pm 0.024 \pm 0.013$					
¹ ACKERSTAFF 97W assu		\rightarrow	$D^{*+}\pi^{-}$	= 0.21	\pm 0.04 and
$\Gamma_{b\overline{b}}/\Gamma_{hadrons} = 0.216$ at	∠ decay.				
$(D_s^-$ anything)/ Γ_{total}					Γ ₄₆ /Γ
ALUE	DOCUMENT ID		TECN	<u>COMMENT</u>	
ALUL					
	¹ BUSKULIC				
0.147±0.017±0.013	$^{ m 1}$ BUSKULIC	96Y	ALEP	$e^+e^- \rightarrow$	Z
0.147±0.017±0.013 ¹ BUSKULIC 96Y reports	1 BUSKULIC 0.183 \pm 0.019 \pm 0	96Y .009 fi	ALEP	$e^+e^- ightarrow$ neasurement	Z of $[\Gamma(\overline{b} -$
$0.147 \pm 0.017 \pm 0.013$ BUSKULIC 96Y reports D_S^- anything)/ $\Gamma_{ ext{total}}$] \times [I	1 BUSKULIC $0.183~\pm~0.019~\pm~0$ B $(D_{m s}^+ ightarrow~\phi\pi^+)]$ ass	96Y .009 fi suming	ALEP rom a r $B(D_s^+ \cdot$	$e^+e^- ightarrow$ measurement $ ightarrow \phi \pi^+)=$	Z of $[\Gamma(\overline{b} - 0.036, \text{ which}]$
0.147±0.017±0.013 ¹ BUSKULIC 96Y reports	1 BUSKULIC $0.183~\pm~0.019~\pm~0$ B $(D_s^+ o \phi \pi^+)$] assue B $(D_s^+ o \phi \pi^+)$	96Y .009 fi suming = (4.5	ALEP from a r $B(D_s^+ + 0.4)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi \pi^+) = \times 10^{-2}$. Out	Z of $[\Gamma(\overline{b}-\overline{b})]$ 0.036, which
$0.147\pm0.017\pm0.013$ 1 BUSKULIC 96Y reports D_{s}^{-} anything)/ Γ_{total}] \times [Example 2007 we rescale to our best valuation their experiment's error and value.	1 BUSKULIC $0.183~\pm~0.019~\pm~0$ B $(D_s^+ o \phi \pi^+)$] assue B $(D_s^+ o \phi \pi^+)$	96Y .009 fi suming = (4.5	ALEP from a r $B(D_s^+ + 0.4)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi \pi^+) = \times 10^{-2}$. Out	Z of $[Γ(\overline{b} - 0.036)]$, which refers the error insing our besign Z
$0.147\pm0.017\pm0.013$ BUSKULIC 96Y reports D_s^- anything)/ Γ_{total}] \times [E we rescale to our best valuation their experiment's error and value. $\Gamma(D_s^+$ anything)/ Γ_{total}	1 BUSKULIC $0.183~\pm~0.019~\pm~0$ $\mathrm{B}(D_s^+ o \phi \pi^+)]$ assue $\mathrm{B}(D_s^+ o \phi \pi^+)$ d our second error is	96Y .009 fi suming = (4.5 the sys	ALEP from a representation $B(D_s^+)$ $\pm 0.4)$ stematic	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ imes$ 10^{-2} . Our error from u	Z of $[\Gamma(\overline{b} - 0.036, \text{ which r first error itsing our bes}]$
$0.147 \pm 0.017 \pm 0.013$ BUSKULIC 96Y reports D_s^- anything)/ Γ_{total}] × [I we rescale to our best valuation their experiment's error and value. $\Gamma(D_s^+$ anything)/ Γ_{total} WALUE	1 BUSKULIC $0.183~\pm~0.019~\pm~0$ B $(D_s^+ o \phi \pi^+)$] assue B $(D_s^+ o \phi \pi^+)$	96Y .009 fi suming = (4.5 the sys	ALEP from a representation $B(D_s^+)$ and $B(D_s^+)$ is stematic.	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ imes$ 10^-2 . Our error from u	Z of $[\Gamma(\overline{b}-0.036, \text{ which r first error in the sing our bes}]$
$0.147 \pm 0.017 \pm 0.013$ BUSKULIC 96Y reports D_s^- anything)/ Γ_{total}] × [I we rescale to our best valuation their experiment's error and value. $\Gamma(D_s^+$ anything)/ Γ_{total} WALUE	1 BUSKULIC $0.183 \pm 0.019 \pm 0$ $\mathrm{B}(D_s^+ o \phi \pi^+)]$ assue $\mathrm{B}(D_s^+ o \phi \pi^+)$ d our second error is 1 ABDALLAH	96Y .009 fi suming = (4.5 the sys	ALEP from a recommendate $B(D_s^+, 0.4)$ stematic $\frac{TECN}{DLPH}$	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ ightarrow$ $ ightarrow$ error from u $ ightarrow$ $ i$	Z of $[\Gamma(\overline{b} - 0.036, \text{ which r first error is sing our bes}]$
D.147±0.017±0.013 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best valuation their experiment's error and value. (D+ anything)/Γ _{total} (ALUE) D.101±0.010±0.029 The second error is the total used in the measurement.	1 BUSKULIC $0.183 \pm 0.019 \pm 0$ $\mathrm{B}(D_s^+ o \phi \pi^+)]$ assue $\mathrm{B}(D_s^+ o \phi \pi^+)$ d our second error is 1 ABDALLAH all of systematic uncertainty	96Y .009 fi suming = (4.5 the sys	ALEP from a recommendate $B(D_s^+, 0.4)$ stematic $\frac{TECN}{DLPH}$	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ ightarrow$ $ ightarrow$ error from u $ ightarrow$ $ i$	Z of $[\Gamma(\overline{b})]$ of $[\Gamma(\overline{b})]$ of $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ of
D.147±0.017±0.013 BUSKULIC 96Y reports D_s^- anything)/ Γ_{total}] × [Find we rescale to our best valuation their experiment's error and value. C(D_s^+ anything)/ Γ_{total} MALUE D.101±0.010±0.029 The second error is the total used in the measurement. C($D \to \Lambda_c^+$ anything)/ Γ_{total}	1 BUSKULIC $0.183\pm0.019\pm0$ $\mathrm{B}(D_s^+\to\phi\pi^+)]$ assue $\mathrm{B}(D_s^+\to\phi\pi^+)$ dour second error is 1 ABDALLAH all of systematic uncertainty	96Y .009 fi suming = (4.5 the sys	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic $\frac{TECN}{DLPH}$ s includi	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ ightarrow$ $ ightarrow$ error from u $ ightarrow$ $ ho$	Z of $[\Gamma(\overline{b})]$ 0.036, which refirst error is sing our best Γ_{47}/Γ Z hing fractions
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. (D _s anything)/Γ _{total} ALUE 1.101±0.010±0.029 1 The second error is the total used in the measurement. (b → Λ _c anything)/Γ _{total} ALUE	1 BUSKULIC $0.183 \pm 0.019 \pm 0$ $\mathrm{B}(D_s^+ o \phi \pi^+)]$ assue $\mathrm{B}(D_s^+ o \phi \pi^+)$ d our second error is 1 ABDALLAH all of systematic uncertainty	96Y .009 fi suming = (4.5 the system	ALEP rom a r $B(D_s^+ + 0.4)$ stematic $\frac{TECN}{DLPH}$ includi	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ 10^{-2} . Our error from under $ ho$ error from $ ho$ on $ ho$ mg the branch $ ho$	Z of $[\Gamma(\overline{b}) - 0.036]$, which refers the error is sing our besing our besing fraction. Γ_{47}/Γ Z hing fraction. Γ_{48}/Γ
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. (D _s anything)/Γ _{total} ALUE 1.101±0.010±0.029 1 The second error is the total used in the measurement. (b → Λ _c anything)/Γ _{total} ALUE	1 BUSKULIC $0.183\pm0.019\pm0$ $\mathrm{B}(D_s^+ o\phi\pi^+)]$ assue $\mathrm{B}(D_s^+ o\phi\pi^+)$ dour second error is 1 ABDALLAH all of systematic uncertail 1 BUSKULIC	96Y .009 fi suming = (4.5 the system 03E etaintie	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic TECN DLPH as includi	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ error from $ ightarrow$ $ ighatarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ig$	Z of $[\Gamma(\overline{b}) - 0.036]$, which is first error is sing our besing our besing Γ_{47}/Γ_{7} Thing fraction Γ_{48}/Γ_{7}
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. (D _s anything)/Γ _{total} ALUE 1 The second error is the total used in the measurement. (b → Λ _c anything)/Γ _{total} ALUE 1.0077±0.011±0.004	1 BUSKULIC $0.183 \pm 0.019 \pm 0$ $\mathrm{B}(D_s^+ o \phi \pi^+)]$ assue $\mathrm{B}(D_s^+ o \phi \pi^+)$ dour second error is 1 ABDALLAH all of systematic uncertal 1 BUSKULIC 1 BUSKULIC 1 0.110 \pm 0.014 \pm 0	96Y .009 fisuming = (4.5 the system) 03E retaintie	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic $\frac{TECN}{DLPH}$ as including $\frac{TECN}{ALEP}$ rom a r	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ error from u $ ightarrow$ $ i$	Z of $[\Gamma(\overline{b} - 0.036, \text{ which refers the error is sing our bessen}]$ Γ_{47}/Γ Z hing fraction Γ_{48}/Γ Z of $[\Gamma(b - 0.036, \text{ which refers the error is sing our bessen}]$
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. (D _s anything)/Γ _{total} ALUE 1.101±0.010±0.029 1 The second error is the total used in the measurement. (b → Λ _c anything)/Γ _{total} ALUE 1.077±0.011±0.004 1 BUSKULIC 96Y reports Λ _c anything)/Γ _{total} Λ _c anything)/Γ _{total}] × [E	1 BUSKULIC $^{0.183}$ \pm $^{0.019}$ \pm 0 B($D_s^+ \rightarrow \phi \pi^+$)] assue B($D_s^+ \rightarrow \phi \pi^+$); dour second error is 1 ABDALLAH all of systematic uncertain 1 BUSKULIC 1 BUSKULIC $^{0.110}$ \pm $^{0.014}$ \pm 0 B($A_c^+ \rightarrow p K^- \pi^+$)]	96Y .009 fisuming = (4.5 the system 03E rtaintie	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic TECN DLPH as includi TECN ALEP rom a r ing $B(A_s^-)$	$e^+e^- ightarrow$ measurement $ ightarrow$ $\phi\pi^+)=$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ $ ightarrow$ error from u $ ightarrow$ $ i$	Z of $[\Gamma(\overline{b} - 0.036, which refers the error is a sing our bessens of the error is sing our bessens our besse$
D.147±0.017±0.013 ¹ BUSKULIC 96Y reports D_s^- anything)/ Γ_{total}] × [E we rescale to our best valuation their experiment's error and value. $\Gamma(D_s^+$ anything)/ Γ_{total} D.101±0.010±0.029 ¹ The second error is the total used in the measurement. $\Gamma(b \rightarrow \Lambda_c^+$ anything)/ Γ_{total} D.077±0.011±0.004 ¹ BUSKULIC 96Y reports	1 BUSKULIC $^{0.183}\pm0.019\pm0$ 1 B($D_{s}^{+}\rightarrow\phi\pi^{+}$)] assue B($D_{s}^{+}\rightarrow\phi\pi^{+}$) and our second error is 1 DOCUMENT ID 1 ABDALLAH all of systematic uncertain 1 BUSKULIC 1 BUSKULIC $^{0.110}\pm0.014\pm0$ B($\Lambda_{c}^{+}\rightarrow\rho K^{-}\pi^{+}$)] est value B($\Lambda_{c}^{+}\rightarrow\rho$	96Y .009 fitsuming = (4.5) the system of	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic TECN DLPH as includi TECN ALEP rom a r ing $B(\Lambda_0^+)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi \pi^+) =$ $ ightarrow 10^{-2}$. Our error from u $ ightarrow COMMENT$ $ ightarrow e^+e^- ightarrow$ measurement $ ightarrow pK^- au$ $ ightarrow 28 \pm 0.32)$	z of $[\Gamma(\overline{b} - 0.036, \text{ which}]$ r first error is sing our bes Γ_{47}/Γ Z hing fraction Γ_{48}/Γ z of $[\Gamma(b - \pi^+) = 0.044]$ × 10^{-2} . Ou
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. Γ(D _s anything)/Γ _{total} VALUE 0.101±0.010±0.029 1 The second error is the total used in the measurement. Γ(b → Λ _c anything)/Γ _{total} VALUE 0.077±0.011±0.004 1 BUSKULIC 96Y reports Λ _c anything)/Γ _{total} which we rescale to our befirst error is their experimental using our best value.	1 BUSKULIC $^{0.183}\pm0.019\pm0$ 1 B($D_{s}^{+}\rightarrow\phi\pi^{+}$)] assue B($D_{s}^{+}\rightarrow\phi\pi^{+}$) and our second error is 1 DOCUMENT ID 1 ABDALLAH all of systematic uncertain 1 BUSKULIC 1 BUSKULIC $^{0.110}\pm0.014\pm0$ B($\Lambda_{c}^{+}\rightarrow\rho K^{-}\pi^{+}$)] est value B($\Lambda_{c}^{+}\rightarrow\rho$	96Y .009 fitsuming = (4.5) the system of	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic TECN DLPH as includi TECN ALEP rom a r ing $B(\Lambda_0^+)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi \pi^+) =$ $ ightarrow 10^{-2}$. Our error from u $ ightarrow COMMENT$ $ ightarrow e^+e^- ightarrow$ measurement $ ightarrow pK^- au$ $ ightarrow 28 \pm 0.32)$	Z of $[\Gamma(\overline{b} - 0.036], \text{ which refers the error is sing our bes}]$ Γ_{47}/Γ Z hing fraction Γ_{48}/Γ z of $[\Gamma(b - 10^{-2}, 0.044] \times 10^{-2}, 0.044]$ where Γ_{48}/Γ_{48}
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. (D _s anything)/Γ _{total} VALUE D.101±0.010±0.029 1 The second error is the total used in the measurement. (D A C anything)/Γ _{total} VALUE D.077±0.011±0.004 1 BUSKULIC 96Y reports A anything)/Γ _{total} VALUE which we rescale to our befirst error is their experimentally anything our best value. (C C anything)/Γ _{total} VALUE	1 BUSKULIC $^{0.183}\pm0.019\pm0$ 1 B($D_{s}^{+}\rightarrow\phi\pi^{+}$)] assue B($D_{s}^{+}\rightarrow\phi\pi^{+}$) and our second error is 1 DOCUMENT ID 1 ABDALLAH all of systematic uncertainty 1 BUSKULIC 1 BUSKULIC $^{0.110}\pm0.014\pm0$ B($\Lambda_{c}^{+}\rightarrow\rho K^{-}\pi^{+}$)] est value B($\Lambda_{c}^{+}\rightarrow\rho E^{-}\pi^{+}$) ent's error and our subsequent identity 1 BUSKULIC 1	96Y 0.009 fixed suming 0.009 0.008 0.009 0	ALEP rom a r $B(D_s^+)$ $\pm 0.4)$ stematic TECN DLPH as includi TECN ALEP rom a r ing $B(\Lambda_0^-)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi\pi^+)= ightarrow 10^{-2}$. Our error from userror from the branch $ ho = \frac{COMMENT}{e^+e^-} ightarrow measurement ho = \frac{COMMENT}{e^+e^-} ho = \frac{e^+e^-}{e^-} ho measurement ho = \frac{e^+e^-}{e^-} ho the systematic from the systema$	Z of $[\Gamma(\overline{b} - 0.036], \text{ which refers the error is sing our bes}]$ Γ_{47}/Γ Z hing fraction Γ_{48}/Γ z of $[\Gamma(b - 10^{-2}, 0.044] \times 10^{-2}, 0.044]$ where Γ_{48}/Γ_{48}
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. Γ(D _s anything)/Γ _{total} VALUE 0.101±0.010±0.029 1 The second error is the total used in the measurement. Γ(b → Λ _c anything)/Γ _{total} VALUE 0.077±0.011±0.004 1 BUSKULIC 96Y reports Λ _c anything)/Γ _{total} which we rescale to our befirst error is their experimentally using our best value. Γ(c̄/c anything)/Γ _{total} VALUE 1.162±0.032 OUR AVERAGE	1 BUSKULIC $^{0.183}$ \pm $^{0.019}$ \pm 0 B($D_s^+ \rightarrow \phi \pi^+$)] assue B($D_s^+ \rightarrow \phi \pi^+$); dour second error is 1 DOCUMENT ID 1 ABDALLAH all of systematic uncertain 1 BUSKULIC 1 BUSKULIC $^{0.110}$ \pm $^{0.014}$ \pm 0 B($\Lambda_c^+ \rightarrow p K^- \pi^+$)] est value B($\Lambda_c^+ \rightarrow p K^- \pi^+$) eent's error and our second 1 DOCUMENT ID 1 Poccument ID 1 BUSKULIC 1	96Y .009 fitsuming = (4.5 the system) = (4.5 the	ALEP rom a r $B(D_S^+)$ $\pm 0.4)$ stematic TECN DLPH as includi TECN ALEP rom a r ing $B(\Lambda_S^-)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi \pi^+) = ightarrow 10^{-2}$. Our error from userror from userro	of $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ of $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ of $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$ on $[\Gamma(\overline{b})]$
1 BUSKULIC 96Y reports D _s anything)/Γ _{total}] × [E we rescale to our best value their experiment's error an value. Γ(D _s anything)/Γ _{total} VALUE 0.101±0.010±0.029 1 The second error is the total used in the measurement. Γ(b → Λ _c anything)/Γ _{total} VALUE 0.077±0.011±0.004 1 BUSKULIC 96Y reports Λ _c anything)/Γ _{total} Which we rescale to our befirst error is their experiment.	1 BUSKULIC $^{0.183}\pm0.019\pm0$ 1 B($D_{s}^{+}\rightarrow\phi\pi^{+}$)] assue B($D_{s}^{+}\rightarrow\phi\pi^{+}$) and our second error is 1 DOCUMENT ID 1 ABDALLAH all of systematic uncertainty 1 BUSKULIC 1 BUSKULIC $^{0.110}\pm0.014\pm0$ B($\Lambda_{c}^{+}\rightarrow\rho K^{-}\pi^{+}$)] est value B($\Lambda_{c}^{+}\rightarrow\rho E^{-}\pi^{+}$) ent's error and our subsequent identity 1 BUSKULIC 1	96Y .009 fitsuming = (4.5 the system) = (4.5 the	ALEP rom a r $B(D_S^+)$ $\pm 0.4)$ stematic TECN DLPH as includi TECN ALEP rom a r ing $B(\Lambda_S^-)$	$e^+e^- ightarrow$ measurement $ ightarrow \phi\pi^+)= ightarrow 10^{-2}$. Our error from userror from the branch $ ho = \frac{COMMENT}{e^+e^-} ightarrow measurement ho = \frac{COMMENT}{e^+e^-} ho = \frac{e^+e^-}{e^-} ho measurement ho = \frac{e^+e^-}{e^-} ho the systematic from the systema$	of $[\Gamma(\overline{b} \rightarrow 0.036], \text{ which r first error is sing our best sing our best sing fractions \Gamma_{47}/\Gamma Z Thing fractions \Gamma_{48}/\Gamma Z of [\Gamma(b \rightarrow \tau^+) = 0.044] \times 10^{-2}. \text{ Our sic error from }\Gamma_{49}/\Gamma$

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98D DLPH $e^+e^- \rightarrow Z$ 1.147 ± 0.041 $1.230 \pm 0.036 \pm 0.065$

$\Gamma(J/\psi(1S))$ anything $\Gamma(J/\psi(1S))$

 Γ_{50}/Γ

(-//(-/-	G// total					50 /
VALUE (units 10^{-2})	CL% EVTS	DOCUMENT ID		TECN	COMMENT	
1.16±0.10 OUR A	AVERAGE					
$1.12\!\pm\!0.12\!\pm\!0.10$					$e^+e^- \rightarrow$	
$1.16\!\pm\!0.16\!\pm\!0.14$	121	² ADRIANI	93J	L3	$e^+e^- \rightarrow$	Z
$1.21\!\pm\!0.13\!\pm\!0.08$		BUSKULIC	92G	ALEP	$e^+e^- \rightarrow$	Z
● ● ● We do not use	e the following data	for averages, fits, li	imits,	etc. • •	•	
$1.3 \pm 0.2 \pm 0.2$		³ ADRIANI	92	L3	$e^+e^- ightarrow$	Z
<4.9	90	MATTEUZZI	83	MRK2	$E_{\rm cm}^{\rm ee}=29$	GeV
	an inclusive measure u^- channels. Assume				Uses $J/\psi(1$	$S) \rightarrow$
² ADRIANI 93J is	an inclusive measure	ement from <i>b</i> deca	ays at	the Z .	Uses $J/\psi(1$	$(S) \rightarrow$
$\mu^+\mu^-$ and J/ψ	$(1S) ightarrow e^{\displaystyle +}e^{\displaystyle -}$ char	nnels.				
³ ADRIANI 92 mea	asurement is an inclu	sive result for $B(Z)$	\rightarrow J	$/\psi(1S)$	$X) = (4.1 \pm$	0.7 \pm
	ch is used to extract					

$\Gamma(\psi(2S))$ anything $\Gamma(\psi(2S))$

 Γ_{51}/Γ

VALUE	DOCUMENT ID		TECN	COMMENT	
• • • We do not use the following	g data for average	s, fits,	limits, e	etc. • • •	
$0.0048 \pm 0.0022 \pm 0.0010$	¹ ABREU	94 P	DLPH	$e^+e^- ightarrow Z$	

 $^{^1}$ ABREU 94P is an inclusive measurement from b decays at the Z. Uses $\psi(2S)
ightarrow$ $J/\psi(1S)\pi^+\pi^-$, $J/\psi(1S) \rightarrow \mu^+\mu^-$ channels. Assumes $\Gamma(Z \rightarrow b\overline{b})/\Gamma_{\rm hadron} = 0.22$.

$\Gamma ig(\psi(2S) \, {\sf anything} ig) / \Gamma ig(J/\psi(1S) \, {\sf anything} ig)$

VALUE	<u>DOCUMENT ID</u>		IECN	COMMENT
0.263 ± 0.013 OUR AVERAGE				
$0.265 \pm 0.002 \pm 0.016$	¹ AAIJ	20 G	LHCB	pp at 13 TeV
$0.266 \pm 0.06 \pm 0.03$	^{2,3} AAIJ			pp at 7 TeV
$0.257 \pm 0.015 \pm 0.019$	^{4,5} CHATRCHYAN	1 12AK	CMS	pp at 7 TeV

 $^{^{1}\,\}mathrm{The}$ first error is statistic; the second error is the total systematic error.

 $^{^{}m 1}$ Measurement performed using an inclusive identification of B mesons and the D candi-

Evaluated via summation of exclusive and inclusive channels.

 $^{^3}$ ABREU 98D results are extracted from a fit to the b-tagging probability distribution based on the impact parameter.

⁴BUSKULIC 96Y assumes PDG 96 production fractions for B^0 , B^+ , B_s , b baryons, and PDG 96 branching ratios for charm decays. This is sum of their inclusive \overline{D}^0 , D^- , \overline{D}_s , and Λ_c branching ratios, corrected to include inclusive Ξ_c and charmonium.

² AAIJ 12BD reports B($b \to \psi(2S)X$) = $(3.08 \pm 0.07 \pm 0.36 \pm 0.27) \times 10^{-3}$ and we divided our best value of B($b \to \psi(1S)X$) = $(1.16 \pm 0.10) \times 10^{-2}$ as the ratio listed here

³ Assumes lepton universality imposing B($\psi(2s) \rightarrow \mu^+\mu^-$) = B($\psi(2s) \rightarrow e^+e^-$).

 $^{^4}$ CHATRCHYAN 12AK really reports $\Gamma_{51}/\Gamma=(3.08\pm0.12\pm0.13\pm0.42)\times10^{-3}$ assuming PDG 10 value of $\Gamma_{50}/\Gamma=(1.16\pm0.10)\times10^{-2}$ which we present as a ratio of Γ_{51}/Γ_{50} $= (26.5 \pm 1.0 \pm 1.1 \pm 2.8) \times 10^{-2}$.

 5 CHATRCHYAN 12AK reports (26.5 \pm 1.0 \pm 1.1 \pm 2.8) imes 10 $^{-2}$ from a measurement of $[\Gamma(\overline{b} \to \psi(2S) \text{ anything})/\Gamma(\overline{b} \to J/\psi(1S) \text{ anything})] \times [B(\psi(2S) \to \mu^+ \mu^-)]$ / $[B(J/\psi(1S) \rightarrow \mu^+\mu^-)]$ assuming $B(\psi(2S) \rightarrow \mu^+\mu^-) = (7.7 \pm 0.8) \times$ 10^{-3} ,B $(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.93 \pm 0.06) \times 10^{-2}$, which we rescale to our best values B $(\psi(2S) \rightarrow \mu^+\mu^-) = (8.0 \pm 0.6) \times 10^{-3}$, B $(J/\psi(1S) \rightarrow \mu^+\mu^-)$ = $(5.961 \pm 0.033) \times 10^{-2}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

$\Gamma(\chi_{c0}(1P))$ anything $\Gamma(\eta_{c}(1S))$ anything

 Γ_{52}/Γ_{56}

$0.32 \pm 0.06 \pm 0.05$	¹ AAIJ	17вв LHCВ	<i>pp</i> at 7, 8 TeV
1 AAIJ 17BB reports $[\Gamma(\overline{b}-\phi\phi)] imes [\mathrm{B}(\chi_{C0}(1P) ightarrow$	$\rightarrow \chi_{c0}(1P)$ anything)	$/\Gamma(\overline{b} o \eta_{\mathcal{C}}(1S)$ a	anything)] $/$ [B($\eta_{m{c}}(1S) ightarrow$
$ \phi \phi\rangle] \times [B(\chi_{c0}(1P) \rightarrow B(x_{c0}(1P))] \times [B(\chi_{c0}(1P) \rightarrow B(x_{c0}(1P))] + B(\chi_{c0}(1P))]$		_	

our best values B($\eta_c(1S) \rightarrow \phi \phi$) = (1.74 ± 0.19) × 10⁻³, B($\chi_{c0}(1P) \rightarrow \phi \phi$) = $(8.0\pm0.7)\times10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

DOCUMENT ID

$\Gamma(\chi_{c1}(1P))$ anything $\Gamma(\chi_{c1}(1P))$

 Γ_{53}/Γ

0.014 ± 0.004 OUR AVERAGE		
$0.0112^{+0.0057}_{-0.0050}\pm0.0003$	¹ ABREU	94P DLPH $e^+e^- o Z$
0.010 ±0.007 ±0.001 10	2 αρρίανι	031 13 6+6- 7

 1 ABREU 94P reports 0.014 \pm 0.006 $^+$ 0.004 from a measurement of $[\Gamma(\overline{b}$ ightarrow $\chi_{c1}(1P)\, {\rm anything})/\Gamma_{\rm total}] \times [{\rm B}(\chi_{c1}(1P) \to \gamma J/\psi(1S))]$ assuming ${\rm B}(\chi_{c1}(1P) \to \gamma J/\psi(1S))=0.273\pm0.016,$ which we rescale to our best value ${\rm B}(\chi_{c1}(1P) \to \gamma J/\psi(1S))=0.273\pm0.016$ $\gamma J/\psi(1S))=(34.3\pm 1.0)\times 10^{-2}.$ Our first error is their experiment's error and our second error is the systematic error from using our best value. Assumes no $\chi_{c2}(1P)$ and $\Gamma(Z \rightarrow b\overline{b})/\Gamma_{hadron} = 0.22$.

 2 ADRIANI 93J reports 0.024 \pm 0.009 \pm 0.002 from a measurement of [Г $(\overline{b}
ightarrow$ $\chi_{c1}(1P)$ anything)/ Γ_{total}] \times [B($\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)$)] assuming B($\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)$) = 0.273 \pm 0.016, which we rescale to our best value B($\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)$) $\gamma J/\psi(1S)$) = (34.3 \pm 1.0) \times 10⁻². Our first error is their experiment's error and our second error is the systematic error from using our best value.

$\Gamma(\chi_{c1}(1P))$ anything $\Gamma(J/\psi(1S))$ anything

 Γ_{53}/Γ_{50}

DOCUMENT ID TECN COMMENT • • • We do not use the following data for averages, fits, limits, etc. • • • 1.92 ± 0.82 121 ¹ ADRIANI 93J L3

$\Gamma(\chi_{c1}(1P))$ anything $\Gamma(\chi_{c0}(1P))$ anything

 Γ_{53}/Γ_{52}

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DOCUMENT ID TECN COMMENT VALUE 17BB LHCB pp at 7, 8 TeV $0.96 \pm 0.21 \pm 0.15$

 $^{^{}m 1}$ ADRIANI 93J is a ratio of inclusive measurements from b decays at the Z using only the $J/\psi(1S) \rightarrow \mu^+\mu^-$ channel since some systematics cancel.

 $^{^1}$ AAIJ 17BB reports $[\Gamma(\overline{b}\to\chi_{c1}(1P)\,\text{anything})/\Gamma(\overline{b}\to\chi_{c0}(1P)\,\text{anything})]/[B(\chi_{c0}(1P)\to\phi\phi)]\times[B(\chi_{c1}(1P)\to\phi\phi)]=0.50\pm0.11\pm0.01$ which we multiply or divide by our best values B($\chi_{c0}(1P) \rightarrow \phi \phi$) = (8.0 ± 0.7) × 10⁻⁴, B($\chi_{c1}(1P) \rightarrow \phi \phi$) $\phi\phi$) = $(4.2 \pm 0.5) \times 10^{-4}$. Our first error is their experiment's error and our second error is the systematic error from using our best values.

	-	S) anything)	D TECI	I COMMENIT	Γ_{53}/Γ_{56}
VALUE 0.31±0.07±0.05		¹ AAIJ	<u>72сг</u> 17вв LHC	<i>COMMENT</i> B <i>pp</i> at 7, 8	TeV
1 AAIJ 17BB reports [Γ $\phi\phi$)] $ imes$ [B(χ_{c1} (1 P)	$(\overline{b} \rightarrow \chi_{C})$ $(\overline{b} \rightarrow \phi \phi)$				
our best values $B(\eta)$					
$(4.2\pm0.5) imes10^{-4}$ the systematic error	. Our firs	t error is their e	experiment's e		
$\Gamma(\chi_{c2}(1P)$ anything))/Γ(χ _{c0} (1P) anything		I COMMENT	Γ_{54}/Γ_{52}
0.42±0.08±0.05				B <i>pp</i> at 7, 8	TeV
1 AAIJ 17 BB reports $[{\sf B}(\chi_{c0}(1P) o\phi\phi]$	$[\Gamma(\overline{b} \rightarrow 0)] \times [B(\chi_{t})]$				
or divide by our best					
$\phi\phi)=(1.06\pm0.09$ error is the systemat				ment's error a	nd our second
$\Gamma(\chi_{c2}(1P))$ anything	$)/\Gamma ig(\eta_c(1$		D TEC	I COMMENT	Γ_{54}/Γ_{56}
<u>VALUE</u> 0.133±0.023±0.018		1 AAIJ	17RR I H <i>C</i>	R nn at 7.8	TeV
1 AAIJ 17BB reports [Γ $\phi\phi$)] $ imes$ [B(χ_{c2} (1 P)	$(\overline{b} \rightarrow \chi_{c2}) \rightarrow \phi \phi)$				
our best values $B(\eta)$					
$(1.06\pm0.09) imes10^{-}$	⁻³ . Our fir	st error is their	experiment's		
the systematic error		g our best value	:5.		
•		•	D 750	COMMENT	Γ ₅₅ /Γ
VALUE	CL%	DOCUMENT I		V COMMENT	
VALUE <2.8 × 10 ⁻⁷	<u>CL%</u> 95	<u>DOCUMENT I</u> AAIJ		<i>COMMENT</i> B pp at 7, 8	
$rac{VALUE}{< 2.8 imes 10^{-7}} \Gamma(\eta_c(1S) ext{anything}) / $	<u>CL%</u> 95	DOCUMENT IN AAIJ Sanything	17вв LHC		TeV
$\frac{VALUE}{<2.8 \times 10^{-7}}$ $\Gamma(\eta_c(1S))$ anything	<u>CL%</u> 95	DOCUMENT IN AAIJ Sanything	17 вв LH С	B <i>pp</i> at 7, 8	TeV Γ₅₆/Γ₅₀
VALUE $<2.8 \times 10^{-7}$ $\Gamma(\eta_c(1S) \text{ anything})/VALUE}$ $0.48 \pm 0.03 \pm 0.06$	<u>CL%</u> 95 /Γ(<i>J/ψ</i>(1	$\frac{DOCUMENT}{AAIJ}$.S) anything) $\frac{DOCUMENT}{AAIJ}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	17BB LHC D TECI 20H LHC nything)	B pp at 7, 8 COMMENT B pp at 13	TeV Γ₅₆/Γ₅₀
$rac{VALUE}{<2.8 imes 10^{-7}}$ $\Gamma(\eta_c(1S) ext{ anything})/VALUE}$ $0.48 \pm 0.03 \pm 0.06$ $\Gamma(\eta_c(2S) ext{ anything, 1})/VALUE ext{ (units } 10^{-5})$	<u>CL%</u> 95 /Γ(<i>J/ψ</i>(1	$\frac{DOCUMENT}{AAIJ}$.S) anything) $\frac{DOCUMENT}{AAIJ}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	17BB LHC D TECI 20H LHC nything)	B pp at 7, 8 COMMENT B pp at 13	TeV Γ₅₆/Γ₅₀ ΓeV Γ₅₇/Γ₅₆
$rac{VALUE}{<2.8 imes 10^{-7}}$ $\Gamma(\eta_c(1S) ext{ anything})/VALUE}$ $0.48 \pm 0.03 \pm 0.06$ $\Gamma(\eta_c(2S) ext{ anything, } 10^{-5})$ $7.0 \pm 2.0 \pm 0.8$	$rac{CL\%}{95}$ $\Gamma(J/\psi(1)$ $m_c ightarrow \phi \phi$	DOCUMENT IN AAIJ 2.5) anything) $\frac{DOCUMENT}{AAIJ}$ 2.6) $\Gamma(\eta_c(1S))$ anything) $\frac{DOCUMENT}{AAIJ}$ 1.7	17BB LHC D TECH 20H LHC nything) D TECH 17BB LHC	B	TeV
$VALUE$ $<2.8 \times 10^{-7}$ $\Gamma(\eta_c(1S) \text{ anything})/VALUE}$ $0.48 \pm 0.03 \pm 0.06$ $\Gamma(\eta_c(2S) \text{ anything}, 10^{-5})$	$ \frac{CL\%}{95} $ $ \sqrt{\Gamma(J/\psi(1)} $ $ \eta_c \to \phi\phi $ $ [\Gamma(\overline{b} \to \eta_c)] = 0.04 $ $ = (1.74 \pm 0.04) $	DOCUMENT IN AAIJ a.S) anything) $\frac{DOCUMENT}{AAIJ}$ b) $/\Gamma(\eta_c(1S)a)$ $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ $\frac{1}{1}$ AOIJ $\frac{1}{1}$ $\frac{1}$ $\frac{1}{1}$ $\frac{1}{1}$ $\frac{1}{1}$ $\frac{1}{1}$ $\frac{1}{1}$ $\frac{1}{1}$	17 BB LHC $D \qquad TECH$ 20 H LHC $D \qquad TECH$ 17 BB LHC 17 BB L	B pp at 7, 8 COMMENT B pp at 13 T COMMENT B pp at 7, 8 pp at 7, 8	TeV Γ_{56}/Γ_{50} FeV Γ_{57}/Γ_{56} TeV $1S) \text{ anything} $ our best value
$VALUE$ $<2.8 \times 10^{-7}$ $\Gamma(\eta_c(1S) \text{ anything})/VALUE$ $0.48 \pm 0.03 \pm 0.06$ $\Gamma(\eta_c(2S) \text{ anything, } n)$ $VALUE \text{ (units } 10^{-5})$ $7.0 \pm 2.0 \pm 0.8$ $1 \text{ AAIJ } 17 \text{BB reports } \text{AAIJ } 17 \text{BB reports } \text{B}(\eta_c(1S) \rightarrow \phi\phi) \text{B}(\eta_c(1S) \rightarrow \phi\phi) \text{B}(\eta_c(1S) \rightarrow \phi\phi) \text{B}(\eta_c(1S) \rightarrow \phi\phi) \text{AAIJ } 17 \text{BB reports } \text{B}(\eta_c(1S) \rightarrow \phi\phi) \text{B}(\eta_c(1S) \rightarrow$	$ \frac{CL\%}{95} $ $ \sqrt{\Gamma(J/\psi(1)} $ $ \eta_c \to \phi\phi $ $ [\Gamma(\overline{b} \to \eta_c)] = 0.04 $ $ = (1.74 \pm 0) $ or is the sys	DOCUMENT IN AAIJ S) anything) DOCUMENT IN AAIJ P)/ $\Gamma(\eta_c(1S)$ a DOCUMENT IN AAIJ $I_c(2S)$ anything,	17BB LHC D $TECH$ 20 H LHC D $TECH$ 17 BB LHC 17 BB L	B pp at 7, 8 COMMENT B pp at 13 COMMENT B pp at 7, 8 $f(\overline{b} \rightarrow \eta_c)$ E multiply by corrist heir expenses to value.	TeV Γ_{56}/Γ_{50} TeV Γ_{57}/Γ_{56} TeV $\Gamma_{5}(S) = \Gamma_{5}(S)$ TeV value eriment's error
$<$ 2.8 \times 10 ⁻⁷ $\Gamma(\eta_c(1S) \text{ anything})/VALUE}$ 0.48 \pm 0.03 \pm 0.06 $\Gamma(\eta_c(2S) \text{ anything, } 10^{-5})$ 7.0 \pm 2.0 \pm 0.8 1 AAIJ 17BB reports $^1/2$ $^$	$ \frac{CL\%}{95} $ $ \sqrt{\Gamma(J/\psi(1)} $ $ \eta_c \to \phi\phi $ $ [\Gamma(\overline{b} \to \eta_c)] = 0.04 $ $ = (1.74 \pm 0) \text{ is the sys} $ $ \frac{1}{2} \sqrt{CL\%} $	DOCUMENT IN AAIJ a.S) anything) $\frac{DOCUMENT}{AAIJ}$ b) $/\Gamma(\eta_c(1S)a)$ $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ $\frac{1}{1}$ $$	17 BB LHC D $TECH$ 20 H LHC D $TECH$ 17 BB LHC $\eta_C \rightarrow \phi \phi$) 004 which we our first error on using our	B pp at 7, 8 COMMENT B pp at 13 COMMENT B pp at 7, 8	TeV Γ_{56}/Γ_{50} TeV Γ_{57}/Γ_{56} TeV $1S) \text{ anything}]$ our best value riment's error
VALUE $ < 2.8 \times 10^{-7} $ $ \Gamma(\eta_c(1S) \text{ anything}) / \text{VALUE} $ $ 0.48 \pm 0.03 \pm 0.06 $ $ \Gamma(\eta_c(2S) \text{ anything, } n) $ $ \frac{\text{VALUE (units } 10^{-5})}{\text{7.0} \pm 2.0 \pm 0.8} $ $ ^1 \text{ AAIJ } 17\text{BB reports } / [\text{B}(\eta_c(1S) \rightarrow \phi_0) = \text{and our second erro}] $ $ \frac{\text{B}(\eta_c(1S) \rightarrow \phi_0) = \text{and our second erro} }{\text{AAIJ } 17\text{BB reports } / (\text{B}(\eta_c(1S) \rightarrow \phi_0) = \text{and our second erro}] $ $ \frac{\text{C}(\chi_{c1}(3872) \text{ anythin } \text{VALUE} }{\text{C}(4.5 \times 10^{-7})} $	$ \frac{CL\%}{95} $ $ \sqrt{\Gamma(J/\psi(1)} $ $ \eta_c \to \phi\phi $ $ [\Gamma(\overline{b} \to \eta_c)] = 0.04 $ $ = (1.74 \pm 0) $ or is the sys $ \frac{18. X_{c1}}{95} $	DOCUMENT IN AAIJ a.S) anything) $\frac{DOCUMENT}{AAIJ}$ b)/ $\Gamma(\eta_c(1S)$ a $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ $\frac{1}{1}$ $\frac{1}{$	17 BB LHC D $TECH$ 20 H LHC D $TECH$ 17 BB LHC $\eta_C \rightarrow \phi \phi$) 004 which we our first error on using our	B pp at 7, 8 COMMENT B pp at 13 COMMENT B pp at 7, 8 $f(\overline{b} \rightarrow \eta_c)$ E multiply by corrist heir expenses to value.	TeV \[\int_{56} / \int_{50} \] TeV \[\text{TeV} \] TeV 1S) anything)] our best value eriment's error \[\int_{58} / \int_{58} \]
$\begin{array}{l} VALUE \\ < 2.8 \times 10^{-7} \\ \hline \Gamma(\eta_c(1S) \text{ anything})/VALUE} \\ \hline 0.48 \pm 0.03 \pm 0.06 \\ \hline \Gamma(\eta_c(2S) \text{ anything, } n)/VALUE} \\ \hline 0.48 \pm 0.03 \pm 0.06 \\ \hline \Gamma(\eta_c(2S) \text{ anything, } n)/VALUE} \\ \hline 0.48 \pm 0.03 \pm 0.06 \\ \hline \Gamma(\eta_c(2S) \text{ anything, } n)/VALUE} \\ \hline 0.48 \pm 0.03 \pm 0.06 \\ \hline \Gamma(\eta_c(1S) \rightarrow 0.06) \\ \hline 0.48 \pm 0.03 \pm 0.06 \\$	$ \frac{CL\%}{95} $ $ \sqrt{\Gamma(J/\psi(1)} $ $ \eta_c \to \phi\phi $ $ [\Gamma(\overline{b} \to \eta_c)] = 0.04 $ $ = (1.74 \pm 0) $ or is the system of the s	DOCUMENT IN AAIJ a.S) anything) $\frac{DOCUMENT}{AAIJ}$ b) $/\Gamma(\eta_c(1S))$ a $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ b) $(0.19) \times 10^{-3}$ atematic error fr $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ AAIJ	17 BB LHC $\frac{D}{20}$ $\frac{TECH}{20}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$	B pp at 7, 8 COMMENT B pp at 13 COMMENT B pp at 7, 8 $f(\overline{b}) \rightarrow \eta_c(\overline{b})$ E multiply by corrist heir expenses to value. COMMENT B pp at 7, 8	TeV Γ_{56}/Γ_{50} TeV Γ_{57}/Γ_{56} TeV $1S) \text{ anything}]$ our best value riment's error
VALUE $ < 2.8 \times 10^{-7} $ $ \Gamma(\eta_c(1S) \text{ anything}) / \text{VALUE} $ $ 0.48 \pm 0.03 \pm 0.06 $ $ \Gamma(\eta_c(2S) \text{ anything, } n) $ $ \frac{\text{VALUE (units } 10^{-5})}{\text{7.0} \pm 2.0 \pm 0.8} $ $ ^1 \text{ AAIJ } 17\text{BB reports } / \text{ [B}(\eta_c(1S) \rightarrow \phi_c)) $ $ = \text{ and our second erro} $ $ \Gamma(\chi_{c1}(3872) \text{ anythin } \frac{\text{VALUE}}{\text{VALUE}} $ $ < 4.5 \times 10^{-7} $	$ \frac{CL\%}{95} $ $ \sqrt{\Gamma(J/\psi(1)} $ $ \eta_c \to \phi\phi $ $ [\Gamma(\overline{b} \to \eta_c)] = 0.04 $ $ = (1.74 \pm 0) $ or is the system of the s	DOCUMENT IN AAIJ a.S) anything) $\frac{DOCUMENT}{AAIJ}$ b) $/\Gamma(\eta_c(1S))$ a $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ b) $(0.19) \times 10^{-3}$ atematic error fr $\frac{DOCUMENT}{1}$ AAIJ $\frac{DOCUMENT}{1}$ AAIJ	17 BB LHC $\frac{D}{20}$ $\frac{TECH}{20}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$ $\frac{TECH}{17}$	B pp at 7, 8 COMMENT B pp at 13 COMMENT B pp at 7, 8	TeV \[\Gamma_{56} / \Gamma_{50} \] TeV \[\Gamma_{57} / \Gamma_{56} \] TeV \[\Gamma_{58} / \Gamma_{59} / \Gamma_{50} / \Gamm

$\Gamma(\overline{s}\gamma)/\Gamma_{\text{total}}$					Γ ₆₀	₀ /Γ
VALUE (units 10^{-4}) CL	.% DOCUMENT ID		TECN	COMMENT		
$3.11 \pm 0.80 \pm 0.72$	¹ BARATE				Z	
• • • We do not use the fol						
< 5.4 90						
<12 90			L3	$e^+e^- \rightarrow$	Z	
¹ BARATE 981 uses lifetim	ne tagged $Z \rightarrow bb$ sar	nple.	10			
² ADAM 96D assumes f_{B^0}	$r_{B^-} = 0.39$ and r_{E}	$B_s = 0$.12.			
³ ADRIANI 93L result is fo	or $b o s \gamma$ is performe	a inclu	sively.			
$\Gamma(\overline{s}\overline{ u} u)/\Gamma_{total}$						1/Γ
<u>VALUE</u> <u>CL</u>	.% DOCUMENT ID					
<6.4 × 10⁻⁴ 90) ¹ BARATE	01E	ALEP	$e^+e^- \rightarrow$	Z	
$^{ m 1}$ The energy-flow and $\it b$ -t	agging algorithms were	used.				
$\Gamma(K^{\pm}$ anything)/ Γ_{total}					Ге	2/Γ
VALUE			TECN	COMMENT	' 02	2/•
0.74±0.06 OUR AVERAGE	<u> </u>		7201	COMMENT		
$0.72 \pm 0.02 \pm 0.06$	BARATE			$e^+e^- \rightarrow$		
$0.88 \pm 0.05 \pm 0.18$	ABREU	95 C	DLPH	$e^+e^- \rightarrow$	Z	
$\Gamma(K_S^0 \text{ anything})/\Gamma_{\text{total}}$					Гс	3/Г
VALUE	DOCUMENT ID		TECN	COMMENT		3/ 1
0.290±0.011±0.027	ABREU			$e^+e^- \rightarrow$		
	ABILLO	33 C	DEITI	c c ,	_	
$\Gamma(\pi^{\pm}$ anything)/ $\Gamma_{ ext{total}}$					Γ ₆ .	4/Γ
VALUE	<u>DOCUMENT ID</u>					
$3.97 \pm 0.02 \pm 0.21$	BARATE	98∨	ALEP	$e^+e^- \rightarrow$	Z	
$\Gamma(\pi^0$ anything) $/\Gamma_{ m total}$					Г.,	₅ /Γ
VALUE	<u>DOCUMENT ID</u>		TECN	COMMENT		5/ '
2.78±0.15±0.60	1 ADAM	96		$e^+e^- \rightarrow$		
¹ ADAM 96 measurement					_	7 、
bb events.	obtained from a fit to	the rap	olaity ais	stribution of	η · · · III Z	<u>-</u> →
F(/ +					_	/-
$\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$	DOCUMENT ID		TECN	COMMENT	1 60	6/F
VALUE 0.0282±0.0013±0.0019	<u>DOCUMENT ID</u> ABBIENDI			$e^+e^- \rightarrow$	7	
0.0202±0.0013±0.0019	ADDIENDI	UUZ	OPAL	e ' e →	2	
$\Gamma(p/\overline{p}anything)/\Gamma_{total}$					Γ ₆	7/F
VALUE			TECN	COMMENT		
0.131±0.011 OUR AVERAG					_	
$0.131 \pm 0.004 \pm 0.011$	BARATE			$e^+e^- ightarrow e^+e^- ightarrow$		
$0.141 \pm 0.018 \pm 0.056$	ABREU	95C	DLPH	e ' e →	Z	
$\Gamma(\Lambda/\overline{\Lambda})$ anything $\Gamma(\Lambda/\overline{\Lambda})$					Γ ₆₈	в/Г
VALUE	DOCUMENT ID		TECN	COMMENT		
0.059 ±0.006 OUR AVER			05		-	
$0.0587 \pm 0.0046 \pm 0.0048$	ACKERSTAF					
$0.059 \pm 0.007 \pm 0.009$	ABREU	95C	DLPH	$e^+e^- \rightarrow$	Z	
h++nc. / /nd~ lbl	Daws 00		C	+ad. 6/1/	2022 00	1.20
https://pdg.lbl.gov	Page 22		Crea	ated: $6/1/$	2022 09	ı.58

$\Gamma(b$ -baryon anything)/ Γ_{total}

 Γ_{69}/Γ

•	,	,	Ο, ,	totai					05/
VALUE					DOCUMENT ID		TECN	COMMENT	
0.102±	0.007	±0.027	,		¹ BARATE	98V	ALEP	$e^+e^- \rightarrow Z$	
1									

¹BARATE 98V assumes B($B_S \rightarrow pX$) = 8 ± 4% and B(b-baryon $\rightarrow pX$) = 58 ± 6%.

$\Gamma(\Xi_b^+ \text{ anything})/\Gamma(\overline{\Lambda}_b^0 \text{ anything})$

VALUE (units 10^{-2})

 Γ_{71}/Γ_{70}

7.3±1.7 OUR AVERAGE			
$6.7 \pm 0.5 \pm 2.1$	1 AAIJ	19AB LHCB	pp at 7 and 8 TeV
$8.2 \pm 0.7 \pm 2.6$	¹ AAIJ	19AB LHCB	pp at 13 TeV
1 Measured from R $=$ [B(\overline{b} $ ightarrow$			<i>D D</i>
$J/\psi \overline{\Lambda}{}^0)]$ and assumes $\Gamma_{\Xi_h^+}$ -	$\rightarrow J/\psi \equiv + \frac{\Gamma}{\Lambda_b^0}$	$\rightarrow J/\psi \overline{\Lambda}^0 = 3/2$	2 related through SU(3)
flavor symmetry.	D		

DOCUMENT ID

TECN

COMMENT

$\Gamma(\text{charged anything})/\Gamma_{\text{total}}$

 Γ_{72}/Γ

VALUE	DOCUMENT	D	IECIV	COMMENT	_
$4.97 \pm 0.03 \pm 0.06$	¹ ABREU	98н	DLPH	$e^+e^- ightarrow Z$	
ullet $ullet$ We do not use the following	ng data for avera	ges, fits,	limits, e	etc. • • •	
$5.84 \pm 0.04 \pm 0.38$	ABREU	95 C	DLPH	Repl. by ABREU 98H	
$^{ m 1}$ ABREU 98H measurement e	xcludes the contri	ibution fr	$rom K^0$	and Λ decay.	

Γ(hadron⁺ hadron⁻)/Γ_{total}

 Γ_{73}/Γ

(() () () () () () ()				13/
VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT	
$1.7^{+1.0}_{-0.7}\pm0.2$	1,2 BUSKULIC 96v	ALEP	$\mathrm{e^{+}e^{-}} ightarrow ~Z$	

 $^{^{1}}$ BUSKULIC 96V assumes PDG 96 production fractions for B^{0} , B^{+} , B_{s} , b baryons.

$\Gamma(\text{charmless})/\Gamma_{\text{total}}$

95

 Γ_{74}/Γ

<u>VALUE</u>	DOCUMENT ID	TECN	COMMENT
0.007±0.021	¹ ABREU 98	DLPH	$e^+e^- \rightarrow Z$

 $^{^1}$ ABREU 98D results are extracted from a fit to the b-tagging probability distribution based on the impact parameter. The expected hidden charm contribution of 0.026 \pm 0.004 has been subtracted.

$\Gamma(\mu^+\mu^- \text{ anything})/\Gamma_{\text{total}}$ Test for $\Delta B=1$ weak neutral current.

 Γ_{76}/Γ

83B JADE $E_{cm}^{ee} = 33-37 \text{ GeV}$

Created: 6/1/2022 09:38

VALUE		CL%	DOCUMENT ID		TECN	COMMENT
<3.2	× 10 ⁻⁴	90	ABBOTT	98 B	D0	p p 1.8 Te\

$< 3.2 \times 10^{-4}$	90	ABBOTT	98 B	D0	<i>p</i> p 1.8 TeV
• • • We do not use the	e following	data for averages	, fits,	limits, e	tc. • • •
$< 5.0 \times 10^{-5}$	90	¹ ALBAJAR	91 C	UA1	$E_{\rm cm}^{p\overline{p}}=$ 630 GeV
< 0.02	95	ALTHOFF	84G	TASS	E ^{ee} _{cm} = 34.5 GeV
< 0.007	95	ADEVA	83	MRKJ	$E_{\mathrm{cm}}^{\mathrm{ee}} = 3038 \; \mathrm{GeV}$

¹ Both ABBOTT 98B and GLENN 98 claim that the efficiency quoted in ALBAJAR 91C was overestimated by a large factor.

< 0.007

BARTEL

 $^{^2}$ Average branching fraction of weakly decaying B hadrons into two long-lived charged hadrons, weighted by their production cross section and lifetimes.

$[\Gamma(e^+e^-\text{ anything}) + \Gamma(\mu^+\mu^-\text{ anything})]/\Gamma_{\text{total}}$ $(\Gamma_{75}+\Gamma_{76})/\Gamma$ Test for $\Delta B = 1$ weak neutral current. DOCUMENT ID TECN COMMENT • • • We do not use the following data for averages, fits, limits, etc. • • • MATTEUZZI 83 MRK2 E_{cm}^{ee} = 29 GeV < 0.008 $\Gamma(\nu \overline{\nu} \text{ anything})/\Gamma_{\text{total}}$ Γ_{77}/Γ DOCUMENT ID TECN COMMENT • • • We do not use the following data for averages, fits, limits, etc. • • • $< 3.9 \times 10^{-4}$ ¹ GROSSMAN 96 RVUE $e^+e^- \rightarrow Z$ 1 GROSSMAN 96 limit is derived from the ALEPH BUSKULIC 95 limit B($B^+ ightarrow ~ au^+ u_ au$) $< 1.8 \times 10^{-3}$ at CL=90% using conservative simplifying assumptions.

χ_h AT HIGH ENERGY

For a discussion of $B\overline{-B}$ mixing, see the note on " $B^0\overline{-B}^0$ Mixing" in the B^0 Particle Listings.

 χ_b is the average $B - \overline{B}$ mixing parameter at high-energy $\chi_b = f_d' \chi_d + f_s' \chi_s$ where f_d' and f_s' are the fractions of B^0 and B_s^0 hadrons in an unbiased sample of semileptonic b-hadron decays.

"OUR EVALUATION" is an average using rescaled values of the data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at https://hflav.web.cern.ch/. The averaging/rescaling procedure takes into account correlations between the measurements.

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.1284±0.0069 OUR EVA	ALUATIO	N			
0.129 ± 0.004 OUR AVE	RAGE				
$0.132\ \pm0.001\ \pm0.024$		¹ ABAZOV	06 S	D0	$p\overline{p}$ at 1.96 TeV
$0.152\ \pm0.007\ \pm0.011$		² ACOSTA	04A	CDF	$p\overline{p}$ at 1.8 TeV
$0.1312 \pm 0.0049 \pm 0.0042$		³ ABBIENDI	03 P	OPAL	$e^+e^- ightarrow~Z$
$0.127\ \pm0.013\ \pm0.006$		⁴ ABREU	01L	DLPH	$e^+e^- ightarrow Z$
$0.1192 \pm 0.0068 \pm 0.0051$		⁵ ACCIARRI	99 D	L3	$e^+e^- ightarrow Z$
$0.121\ \pm0.016\ \pm0.006$		⁶ ABREU	94J	DLPH	$e^+e^- ightarrow~Z$
$0.114\ \pm0.014\ \pm0.008$		⁷ BUSKULIC	94G	ALEP	$e^+e^- ightarrow Z$
0.129 ± 0.022		⁸ BUSKULIC	92 B	ALEP	$e^+e^- ightarrow Z$
$0.176\ \pm0.031\ \pm0.032$	1112	⁹ ABE	91 G	CDF	<i>p</i>
$0.148 \pm 0.029 \pm 0.017$		¹⁰ ALBAJAR	91 D	UA1	<i>p</i> p 630 GeV
ullet $ullet$ We do not use the	following	data for averages,	fits, li	mits, etc	5. • • •
$0.131 \ \pm 0.020 \ \pm 0.016$		¹¹ ABE	971	CDF	Repl. by
$0.1107\!\pm\!0.0062\!\pm\!0.0055$		¹² ALEXANDER	96	OPAL	ACOSTA 04A Rep. by ABBI- ENDI 03P
$0.136 \ \pm 0.037 \ \pm 0.040$		¹³ UENO	96	AMY	e^+e^- at 57.9 GeV
$0.144 \ \pm 0.014 \ ^{+ \ 0.017}_{- \ 0.011}$		¹⁴ ABREU	94F	DLPH	Sup. by ABREU 94J
0.131 ± 0.014		¹⁵ ABREU	94J	DLPH	$e^+e^- ightarrow Z$
$0.123 \pm 0.012 \pm 0.008$		ACCIARRI	94 D	L3	Repl. by ACCIA- RRI 99D
https://pdg.lbl.gov		Page 24		Create	ed: 6/1/2022 09:38

$0.157\ \pm0.020\ \pm0.032$		¹⁶ ALBAJAR	94	UA1	$\sqrt{s}=$ 630 GeV
$0.121 \ ^{+ 0.044}_{- 0.040} \ \pm 0.017$	1665	¹⁷ ABREU	93C	DLPH	Sup. by ABREU 94J
$0.143 \ ^{+0.022}_{-0.021} \ \pm 0.007$		¹⁸ AKERS	93 B	OPAL	Sup. by ALEXAN- DER 96
$0.145 \ ^{+ 0.041}_{- 0.035} \ \pm 0.018$		¹⁹ ACTON	92C	OPAL	$e^+e^- ightarrow Z$
$0.121 \pm 0.017 \pm 0.006$		²⁰ ADEVA	92 C	L3	Sup. by ACCIA- RRI 94D
$\begin{array}{ccc} 0.132 & \pm 0.22 & +0.015 \\ -0.012 & \end{array}$	823	²¹ DECAMP	91	ALEP	$e^+e^- ightarrow Z$
$0.178 \ ^{+ 0.049}_{- 0.040} \ \pm 0.020$		²² ADEVA	90 P	L3	$e^+e^- ightarrow Z$
$0.17 {}^{+ 0.15}_{- 0.08}$	23	^{3,24} WEIR	90	MRK2	e^+e^- 29 GeV
$0.21 \begin{array}{c} +0.29 \\ -0.15 \end{array}$		²³ BAND	88	MAC	E ^{ee} _{cm} = 29 GeV
>0.02 at 90% <i>CL</i>		²³ BAND	88	MAC	$E_{\rm cm}^{\rm ee} = 29 \; {\rm GeV}$
0.121 ± 0.047	23	^{3,25} ALBAJAR	87C	UA1	- 1
<0.12 at 90% <i>CL</i>	23	^{3,26} SCHAAD	85	MRK2	JAR 91D Eee = 29 GeV

 $\frac{1}{2}$ Uses the dimuon charge asymmetry. Averaged over the mix of *b*-flavored hadrons.

² Measurement performed using events containing a dimuon or an e/μ pair.

The average B mixing parameter is determined simultaneously with b and c forwardbackward asymmetries in the fit.

⁴ The experimental systematic and model uncertainties are combined in quadrature.

 5 ACCIARRI 99D uses maximum-likelihood fits to extract χ_h as well as the A_{FR}^b in Z o $b\overline{b}$ events containing prompt leptons.

 6 This ABREU 94J result is from 5182 $\ell\ell$ and 279 $\Lambda\ell$ events. The systematic error includes 0.004 for model dependence.

⁷ BUSKULIC 94G data analyzed using ee, $e\mu$, and $\mu\mu$ events.

⁸ BUSKULIC 92B uses a jet charge technique combined with electrons and muons.

 9 ABE 91G measurement of χ is done with $e\mu$ and ee events.

 10 ALBAJAR 91D measurement of χ is done with dimuons.

11 Uses di-muon events.

- 12 ALEXANDER 96 uses a maximum likelihood fit to simultaneously extract χ as well as the forward-backward asymmetries in $e^+e^-
 ightarrow Z
 ightarrow b\,\overline{b}$ and $c\,\overline{c}$.
- 13 UENO 96 extracted χ from the energy dependence of the forward-backward asymmetry.
- 14 ABREU 94F uses the average electric charge sum of the jets recoiling against a $\it b$ -quark jet tagged by a high p_T muon. The result is for $\overline{\chi} = f_d \chi_d + 0.9 f_s \chi_s$.
- ¹⁵ This ABREU 94J result combines $\ell\ell$, $\Lambda\ell$, and jet-charge ℓ (ABREU 94F) analyses. It is for $\overline{\chi}=f_d\chi_d+0.96f_s\chi_s$. 16 ALBAJAR 94 uses dimuon events. Not independent of ALBAJAR 91D.
- 17 ABREU 93C data analyzed using $e\,e,\,e\,\mu,$ and $\mu\,\mu$ events.
- ¹⁸ AKERS 93B analysis performed using dilepton events.
- 19 ACTON 92C uses electrons and muons. Superseded by AKERS 93B.
- 20 ADEVA 92C uses electrons and muons. 21 DECAMP 91 done with opposite and like-sign dileptons. Superseded by BUSKULIC 92B.
- 22 ADEVA 90P measurement uses ee, $\mu\mu$, and $e\mu$ events from 118k events at the Z. Superseded by ADEVA 92C.
- These experiments are not in the average because the combination of B_s and B_d mesons which they see could differ from those at higher energy.
- ²⁴ The WEIR 90 measurement supersedes the limit obtained in SCHAAD 85. The 90% CL
- are 0.06 and 0.38. 25 ALBAJAR 87C measured $\chi=(\overline B^0 o B^0 o \mu^+{\rm X})$ divided by the average production weighted semileptonic branching fraction for B hadrons at 546 and 630 GeV.
- 26 Limit is average probability for hadron containing B quark to produce a positive lepton.

CP VIOLATION PARAMETERS in semileptonic b-hadron decays.

$Re(\epsilon_b) / (1 + |\epsilon_b|^2)$

CP impurity in semileptonic b-hadron decays.

VALUE (units 10^{-3})	DOCUMENT ID	TEC	CN COMMENT				
ullet $ullet$ We do not use the following data for averages, fits, limits, etc. $ullet$ $ullet$							
$-6.2 \pm 5.2 \pm 4.7$ $-1.24 \pm 0.38 \pm 0.18$ $-1.97 \pm 0.43 \pm 0.23$ $-2.39 \pm 0.63 \pm 0.37$	¹ AABOUD ² ABAZOV ³ ABAZOV ⁴ ABAZOV	17E ATI 14 D0 11U D0 10H D0	ρ p at 1.96 TeV Repl. by ABAZOV :				
1 AABOUD 17E reports a measurement of charge asymmetry of ${\rm A}_{SL}^b=(-25\pm21\pm19)\times10^{-3}$ in lepton $+$ jets $t\overline{t}$ events in which a b -hadron decays semileptonically to a soft muon. 2 ABAZOV 14 reports a measurement of like-sign dimuon charge asymmetry of ${\rm A}_{SL}^b=(-4.96\pm1.53\pm0.72)\times10^{-3}$ in semileptonic b -hadron decays. 3 ABAZOV 11U reports a measurement of like-sign dimuon charge asymmetry of ${\rm A}_{SL}^b=(-7.87\pm1.72\pm0.93)\times10^{-3}$ in semileptonic b -hadron decays. 4 ABAZOV 10H reports a measurement of like-sign dimuon charge asymmetry of ${\rm A}_{SL}^b=(-9.57\pm2.51\pm1.46)\times10^{-3}$ in semileptonic b -hadron decays. Using the measured production ratio of ${\rm B}_d^0$ and ${\rm B}_s^0$, and the asymmetry of ${\rm B}_d^0$ as ${\rm A}_{SL}^a=(-4.7\pm4.6)\times10^{-3}$ measured from B -factories, they obtain the asymmetry for ${\rm B}_s^0$ as ${\rm A}_{SL}^s=(-14.6\pm7.5)\times10^{-3}$.							

B-HADRON PRODUCTION FRACTIONS IN $p\bar{p}$ COLLISIONS AT Tevatron

The production fractions for b-hadrons in $p\bar{p}$ collisions at the Tevatron have been calculated from the best values of mean lifetimes, mixing parameters, and branching fractions in this edition by the Heavy Flavor Averaging Group (HFLAV) (see https://hflav.web.cern.ch/).

The values reported below assume:

$$\begin{array}{ll} \mathsf{f}(\overline{b}\to B^+) = \mathsf{f}(\overline{b}\to B^0) \\ \mathsf{f}(\overline{b}\to B^+) + \mathsf{f}(\overline{b}\to B^0) + \mathsf{f}(\overline{b}\to B^0) + \mathsf{f}(\overline{b}\to B^0) + \mathsf{f}(b\to b\text{-baryon}) = 1 \\ \mathsf{ne} \text{ values are:} \end{array}$$

$$f(\overline{b} \rightarrow B^+) = f(\overline{b} \rightarrow B^0) = 0.344 \pm 0.022$$

$$f(\overline{b} \to B_s^0) = 0.115 \pm 0.013$$

$$f(b \to b - baryon) = 0.198 \pm 0.046$$

The values are:
$$f(\overline{b} \rightarrow B^+) = f(\overline{b} \rightarrow B^0) = 0.344 \pm 0.021$$

$$f(\overline{b} \rightarrow B_s^0) = 0.115 \pm 0.013$$

$$f(b \rightarrow b\text{-baryon}) = 0.198 \pm 0.046$$

$$f(\overline{b} \rightarrow B_s^0) / f(\overline{b} \rightarrow B_d^0) = 0.334 \pm 0.041$$
 and their correlation coefficients are:
$$cor(B_s^0, b\text{-baryon}) = -0.429$$

$$cor(B_s^0, B^+ = B^0) = +0.159$$

$$cor(B_s^0, b$$
-baryon $) = -0.429$

$$cor(B_s^0, B^+=B^0) = +0.159$$

$$cor(b$$
-baryon, $B^+ = B^0$) = -0.960

as obtained with the Tevatron average of time-integrated mixing parameter $\overline{\chi} = 0.147 \pm 0.011.$

PRODUCTION ASYMMETRIES

$\mathsf{A}_C^{b\overline{b}}$

$$\begin{split} &\mathsf{A}_C^{b\,\overline{b}} = \left[\mathsf{N}(\Delta \mathsf{y}>0) - \mathsf{N}(\Delta \mathsf{y}<0)\right] / \left[\mathsf{N}(\Delta \mathsf{y}>0) + \mathsf{N}(\Delta \mathsf{y}<0)\right] \text{ with } \Delta \mathsf{y} = \left|\mathsf{y}_b\right| - \left|\mathsf{y}_{\overline{b}}\right| \\ &\mathsf{where} \ \mathsf{y}_{b/\overline{b}} \ \mathsf{is} \ \mathsf{rapidity} \ \mathsf{of} \ b \ \mathsf{or} \ \overline{b} \ \mathsf{quarks}. \end{split}$$

$VALUE$ (units 10^{-2})	DOCUMENT ID	TECN	COMMENT
Average is meaningless.			
$0.4 \pm 0.4 \pm 0.3$	$^{ m 1}$ AAIJ	14AS LHCB	pp at 7 TeV
$2.0 \pm 0.9 \pm 0.6$	² AAIJ	14AS LHCB	pp at 7 TeV
$1.6 \pm 1.7 \pm 0.6$	³ AAIJ	14AS LHCB	pp at 7 TeV
¹ Measured for $40 < M(b\overline{b}) <$	75 GeV/c ²		

$B^{\pm}/B^0/B_s^0/b$ -baryon ADMIXTURE REFERENCES

AAIJ	21Y	PR D104 032005	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	20G	EPJ C80 185	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	20H	EPJ C80 191	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	20V	PRL 124 122002	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	19AB	PR D99 052006	R. Aaij et al.	(LHCb Collab.)
AAIJ	19AD	PR D100 031102	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	19AI	PR D100 112006	R. Aaij <i>et al.</i>	(LHCb Collab.)
AABOUD	17E	JHEP 1702 071	M. Aaboud <i>et al.</i>	(ATLAS Collab.)
AAIJ		EPJ C77 609	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAD		PRL 115 262001	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAIJ		PRL 113 082003	R. Aaij <i>et al.</i>	(LHCb Collab.)
ABAZOV	14/13	PR D89 012002	V.M. Abazov <i>et al.</i>	(D0 Collab.)
AAIJ	13P	JHEP 1304 001	R. Aaij <i>et al.</i>	(LHCb Collab.)
AAIJ	-	EPJ C72 2100	R. Aaij <i>et al.</i>	(LHCb Collab.)
Also	1200	EPJ C80 49 (errat.)	•	` '
AALJ	10.1		R. Aaij <i>et al.</i>	(LHCb Collab.)
	12J	PR D85 032008	R. Aaji <i>et al.</i>	(LHCb Collab.)
		JHEP 1202 011	S. Chatrchyan et al.	(CMS Collab.)
AAIJ	11F	PRL 107 211801	R. Aaij <i>et al.</i>	(LHCb Collab.)
ABAZOV	11U	PR D84 052007	V.M. Abazov et al.	(D0 Collab.)
ABAZOV	10H	PRL 105 081801	V.M. Abazov et al.	(D0 Collab.)
Also		PR D82 032001	V.M. Abazov <i>et al.</i>	(D0 Collab.)
PDG	10	JP G37 075021	K. Nakamura <i>et al.</i>	(PDG Collab.)
AALTONEN	09E	PR D79 032001	T. Aaltonen <i>et al.</i>	(CDF Collab.)
AALTONEN	08N	PR D77 072003	T. Aaltonen <i>et al.</i>	(CDF Collab.)
ABAZOV	06S	PR D74 092001	V.M. Abazov <i>et al.</i>	(D0 Collab.)
ABBIENDI	04I	EPJ C35 149	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABDALLAH	04E	EPJ C33 307	J. Abdallah <i>et al.</i>	(DELPHI Collab.)
ACOSTA	04A	PR D69 012002	D. Acosta et al.	(CDF Collab.)
ABBIENDI	03M	EPJ C30 467	G. Abbiendi <i>et al.</i>	(ÒPAL Collab.)
ABBIENDI	03P	PL B577 18	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABDALLAH	03E	PL B561 26	J. Abdallah <i>et al.</i>	(DELPHI Collab.)
ABDALLAH	03K	PL B576 29	J. Abdallah <i>et al.</i>	(DELPHI Collab.)
HEISTER	02G	EPJ C22 613	A. Heister <i>et al.</i>	`(ALEPH Collab.)
ABBIENDI	01Q	PL B520 1	G. Abbiendi <i>et al.</i>	`(OPAL Collab.)
ABBIENDI	01R	EPJ C21 399	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABREU	01L	EPJ C20 455	P. Abreu <i>et al.</i>	(DELPHI Collab.)
BARATE	01E	EPJ C19 213	R. Barate et al.	(ALEPH Collab.)
ABBIENDI	00E	EPJ C13 225	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABBIENDI	00Z	PL B492 13	G. Abbiendi <i>et al.</i>	(OPAL Collab.)
ABREU	00	EPJ C12 225	P. Abreu et al.	(DELPHI Collab.)
ABREU	00C	PL B496 43	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ABREU	00D	PL B478 14	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ABREU	00B	PL B475 407	P. Abreu <i>et al.</i>	(DELPHI Collab.)
ACCIARRI	00	EPJ C13 47	M. Acciarri <i>et al.</i>	(L3 Collab.)
AFFOLDER	00E	PRL 84 1663	T. Affolder <i>et al.</i>	(CDF Collab.)
ABBIENDI	99 J	EPJ C12 609	G. Abbiendi <i>et al.</i>	
ADDILINDI	aal	LI J C12 009	G. Abbieliul et al.	(OPAL Collab.)

 $^{^{1}}$ Measured for 40 < M($b\overline{b}$) < 75 GeV/ c^{2} . 2 Measured for 75 < M($b\overline{b}$) < 105 GeV/ c^{2} . 3 Measured for M($b\overline{b}$) > 105 GeV/ c^{2} .

ACCJARRI 99D PL B448 152 M. Acciarri et al. (ALEPH Collab.) ABBOTT 98B PL B423 419 B. Abbott et al. (DC Collab.) ABBOTT 98B PL B423 419 B. Abbott et al. (DC Collab.) ABREU 98D PL B426 193 P. Abreu et al. (DC Collab.) ABREU 98D PL B426 193 P. Abreu et al. (DELPHI Collab.) ABREU 98D PL B426 193 P. Abreu et al. (DELPHI Collab.) ACCJARRI 98 PL B436 220 M. Acciarri et al. (LS Collab.) ACCJARRI 98 PL B436 174 M. Acciarri et al. (LS Collab.) ACCJARRI 98 PL B436 174 M. Acciarri et al. (LS Collab.) ACCJARRI 98 PL B436 174 M. Acciarri et al. (LS Collab.) ACCJARRI 98 PL B436 174 M. Acciarri et al. (LS Collab.) ACCJARRI 98 PL B436 174 M. Acciarri et al. (LS Collab.) ACCJARRI 980 PL C 2010 R. Barate et al. (ALEPH Collab.) ACCJARRI 980 PL C 2010 R. Barate et al. (ALEPH Collab.) ABRATT 980 PL C 2010 R. Barate et al. (ALEPH Collab.) ABRET 971 PR D55 2346 F. Abe et al. (ALEPH Collab.) ABRET 971 PR D55 2346 F. Abe et al. (CDF Collab.) ACKERSTAFF 977 PLYHY C74 423 K. Ackerstaff et al. (CDF Collab.) ACKERSTAFF 977 PLYHY C74 33 97 K. Ackerstaff et al. (OPAL Collab.) ACKERSTAFF 977 PLYHY C74 423 K. Ackerstaff et al. (OPAL Collab.) ACKERSTAFF 977 PLYHY C74 423 K. Ackerstaff et al. (OPAL Collab.) ACKERSTAFF 970 PLYHY C76 425 K. Ackerstaff et al. (OPAL Collab.) ADAM 96 PL B337 105 P. Abreu et al. (DELPHI Collab.) ADAM 96 PL B347 105 P. Abreu et al. (DELPHI Collab.) ADAM 96 PL PST 107 1379 M. Acciarri et al. (DAL Collab.) ADAM 96 PL PST 107 1379 M. Acciarri et al. (DELPHI Collab.) ADAM 96 PL PST 107 1379 M. Acciarri et al. (DELPHI Collab.) ADAM 96 PL PST 107 107 107 M. Acciarri et al. (DELPHI Collab.) ADAM 96 PL B381 471 D. Buskulic et al. (LEPH Collab.) ADAM 96 PL B381 471 D. Buskulic et al. (ALEPH Collab.) ABREU 99 PL B383 4471 D. Buskulic et al. (ALEPH Collab.) ABREU 99 PL B383 4471 D. Buskulic et al. (ALEPH Collab.) ABREU 99 PL B383 471 D. Buskulic et al. (ALEPH Collab.) ABREU 99 PL B383 471 D. Buskulic et al. (DELPHI Collab.) ABREU 99 PL B383 474 D. Buskulic et al. (DELPHI Collab.) ABREU 99 PL B383 474 D. Buskulic et al. (DELPHI Co	ABE	99P	PR D60 092005	F. Abe et al.	(CDF Collab.)
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